

CATALOGUE
OF
HOWARDS' PATENT
PLOUGHING ENGINES,
STEAM CULTIVATORS,
AND
STEAM PLOUGHS,
MANUFACTURED BY
JAMES & FRED^K HOWARD,
BRITANNIA IRON WORKS,
BEDFORD.

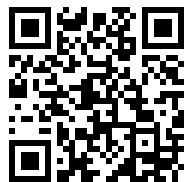
LONDON OFFICE:
4, CHEAPSIDE, E.C., THREE DOORS FROM ST. PAUL'S.

JULY 1, 1867.

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HOWARDS' STEAM CULTIVATING APPARATUS ON THE SINGLE ENGINE SYSTEM.



Price of a Ten-horse set, with Portable Engine, complete as above, £520.

Price of a similar set, but with Patent Twelve-horse Ploughing Engine with Double Drums, instead of a Portable Engine and Windlass, £800.

HOWARDS'

PATENT

STEAM CULTIVATING

AND

PLOUGHING APPARATUS.

In introducing their CATALOGUE of AGRICULTURAL MACHINERY, J. & F. HOWARD have the following remarks to offer on the subject of

STEAM CULTIVATION.

THEY HAVE NOW MANUFACTURED AND SOLD UPWARDS OF

FIVE HUNDRED

STEAM PLOUGHS AND CULTIVATORS.

They have therefore had considerable practice in this important branch, and have also had much experience in cultivating their own farms by steam power. They have, besides, made themselves acquainted with the opinions and experience of Farmers who have adopted Steam Cultivation, under various circumstances, and in different countries.

J. & F. Howard now manufacture two kinds of Steam Cultivating Apparatus on separate and distinct systems.

For Public Companies, large occupiers, or persons who purchase such machinery to let on hire, J. & F. Howard recommend their new Patent Double Engine system ; but for persons who intend simply to cultivate their own farms the Single Engine system is more suitable, being thoroughly efficient, and only half the price of the other.

After many years' experience, J. & F. Howard believe the following are established as the advantages of steam power in the cultivation of the soil :—

1. That for the hard work of the farm steam is a cheaper power than horse power.
2. That deeper and more efficient cultivation is obtained.
3. That it enables the farmer to perform his tillage operations at the best season of the year.
4. That better crops with less manure can be obtained by continuous deep tillage, especially on clays and loams.
5. That the land may be more quickly and effectually cleaned and freed from weeds.
6. That tenacious soils are rendered more friable and porous, good drainage is promoted by stirring the subsoil and breaking the "pan," and open furrows are unnecessary, even on the strongest land.
7. That the Steam Cultivator, Plough, or Harrows may be frequently worked to advantage in an unfavourable season, when to work with horses would be impossible.
8. That not only a considerable diminution in the number of horses employed can be effected, but that the horses which are still necessary can be kept at less expense, being relieved of their most laborious work.

To secure these advantages, the Apparatus should be—

Simple in its construction,
Easily understood and managed by ordinary farm labourers,
Readily adapted to work in any desired position,
Moderate in its first cost, and
Economical in wear.

The great satisfaction expressed by the numerous purchasers of J. & F. Howard's Steam Cultivating Machinery, proves that their efforts to combine these features have been most successful: they do not know a single Farmer who has adopted their Apparatus who would return to horse power for his tillage operations.

J. & F. Howard have pleasure in stating that they have introduced additional improvements, which effect a saving of power, add to the durability of the Apparatus, and greatly reduce the wear of the steel ropes.

The Apparatus, illustrated on page 2, is adapted for hilly as well as flat land, and for irregularly-shaped as well as square fields. As the Engine and Windlass are stationary while in operation, the expense of carting water is often avoided by digging a pond or well at convenient points; and if set in an adjoining field, which is recommended when practicable, the whole field can be cultivated, headlands included, without the engine being taken into it. As many as 40 or even 50 acres of land can be advantageously cultivated without any removal of the Engine or Windlass.

From 7 to 10 acres a day can be broken up with an ordinary 8 or 10-horse Portable Engine. The Engine requires no alteration whatever, and is of course available for thrashing, &c., when not required on the land.

HOWARDS' PATENT WINDLASS.

The Windlass is of the most simple construction. The winding drums revolve on a very strong wrought-iron axle, attached to brackets which carry the driving shaft and a pair of travelling wheels. This arrangement affords great strength and stability. The windlass is very portable, and is quickly set down to work. By a simple lever movement, the winding drums drop out of gear instantaneously, which enables the windlass-man to attend to the proper coiling of the rope, on which its preservation so much depends; and also, in case of accident, to stop the plough or cultivator in an instant, without stopping the engine. The pinions which gear into the drum-wheels are of malleable iron, and are keyed fast to the shaft. The liability to breakage is thereby much lessened, and the rattle and wear of sliding pinions or clutches are entirely avoided.

HOWARDS' PATENT DOUBLE SNATCH BLOCK.

The Double Snatch Block, combined with the arrangement for keeping the slack rope clear off the ground, is fixed in front of the windlass, and from it the ropes may be led off in any required direction. It prevents the rope from dragging on the ground between the porters, and the wear from friction is reduced to a minimum. The importance of this arrangement will be apparent when it is remembered that about ten times more power is required to drag a rope along the ground, than when it is properly carried by rollers.

HOWARDS' PATENT DOUBLE-ACTION STEAM CULTIVATOR

This implement, which effectually cuts up the land at one operation, is made with a very strong flanged steel frame, combining great strength with comparatively little weight. It is fitted with five tines, but can be used with four, three, two, or one, according to the depth and tenacity of the soil. The shares are made of various widths, from two inches up to thirteen inches, and are furnished with prongs, which lift up the soil and leave it loose. The tines rock on the frame, so that as the points in work are depressed, the hinder ones are slightly raised. The wheels are steered by the ploughman alternately at each end, according to the direction in which the implement is going. In case of stoppage from extra hard or foul land, the Cultivator can instantly be drawn back and again driven at the work at full speed. A Harrow can be attached to the side of the Cultivator, to work the ground already turned up, thus effecting two operations at one time.

HOWARDS' PATENT DOUBLE-ACTION STEAM PLOUGH.

This implement is made for either two, three, or four furrows. The right and left hand Ploughs are fixed to very strong flanged steel frames, which cross each other at their inner ends, thereby decreasing the length of the Plough, and consequently the width of the headland. The frames are raised and lowered in such a manner that the set of ploughs out of work is independent of, and has no tendency to weigh or raise out of the ground, the set in work. This adds greatly to the steadiness of the implement in hard work and on hilly land. The steerage, and the methods of altering the depth of the wheels are very simple. By substituting suitable breasts and shares, the plough may be used for scarifying, digging, ridging, or subsoiling.

HOWARDS' PATENT STEAM HARROWS.

These Harrows are on the same principle as J. & F. Howard's Drag Harrows for horse power, but made to work either backwards or forwards, like the Steam Cultivator, the attendant steering them in the same manner. They are most useful implements after the land has been broken up by the Steam Cultivator, and 15 to 20 acres a day may be done with them much more effectually than by horse power.

The following Judges' Report on Steam Harrows appeared in the *Journal* of the Royal Agricultural Society of England:—

NEWCASTLE MEETING.—“Messrs. Howard's Steam Harrows, made on the zigzag principle, and provided with a simple steerage and seat for the workman, are excellent implements for crossing fallows in the spring. The length of tines and weight of frame cause all these implements to work rather as Cultivators, cutting through the furrow, than as harrows proper. The width taken is so great that, in order to break fresh ground at each turn, the harrow has to start forward a short distance, then retrace its steps, and thus get into its proper track. Looking at the moderate cost of these drag-harrows, the quantity of work they could accomplish, the quality of the operation, and their adaptation for any kind of steam power, we think Messrs. Howard have produced a very valuable implement. We award the prize of £20 to J. & F. Howard.”

HOWARDS' PATENT ROPE PORTER.

Those who have adopted Steam Cultivation are aware of the constant attention required to see that the lads keep a sufficient number of Porters under the rope. This has led J. & F. Howard to invent their New Patent Lever Rope Porters, which are much less trouble to the boys than any hitherto in use, as they can be released from the rope instantaneously, and with the greatest ease and safety. They are made entirely of iron, are mounted on two wheels, and readily adjust themselves to the draught of the rope.

THE SET OF STEAM CULTIVATING APPARATUS CONSISTS OF

- The Patent Windlass.
- 1600 yards of Patent Steel Wire Rope.
- Universal Joint, for connecting the Windlass with Engine.
- Patent Double-action Steam Cultivator, with five tines.
- Patent Double Snatch Block, with arrangement for slack rope.
- 5 Single Snatch Blocks.
- 7 Iron Anchors.
- 4 Wood or Dead Anchors.
- 21 Rope Porters.
- 2 Anchor Couplings.
- 2 Beetles.
- 3 Wood Levers.
- 2 Crowbars.
- 1 Connecting Chain.
- 1 Rope Coiler.

Price for the whole, being everything required, except Engine ... £250

J. & F. Howard do not pay the carriage of Steam Cultivating Apparatus, but they allow 2½ per cent. discount for cash in a month from date of Invoice. Having made special arrangements with the different Railway Companies to forward the Apparatus at greatly reduced through rates to almost every station in Great Britain, the above discount will, in many cases, cover the cost of carriage.

PATENT PORTABLE STEAM ENGINES.



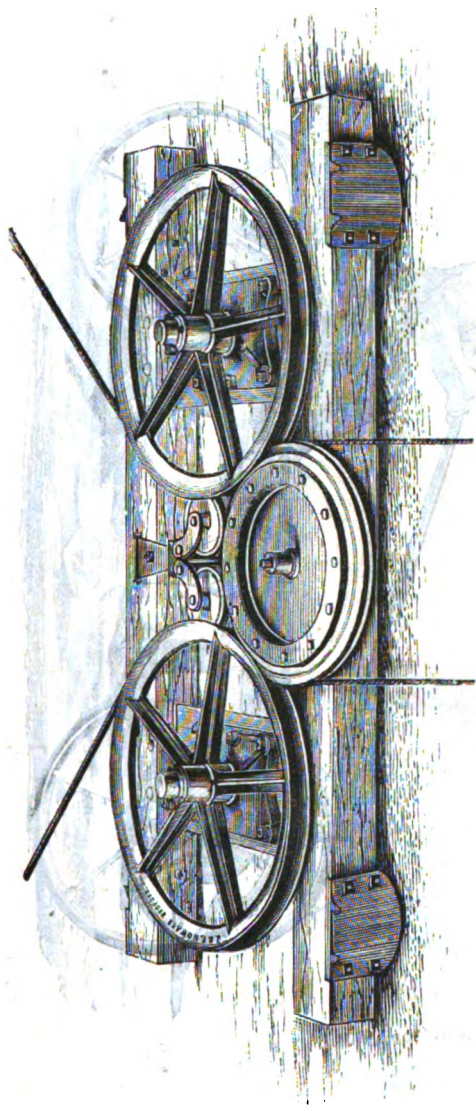
The above are manufactured specially for Steam Cultivation, with double cylinders, which for such work are found preferable, with extra large and strong boilers for working at a high pressure, and with every appliance for economizing the fuel.

These Engines are equally well adapted for thrashing and other agricultural purposes.

			£	s.	d.
Price of 8-horse Patent Double Cylinder Portable Engine	...	...	250	0	0
Price of 10-horse Patent Double Cylinder Portable Engine	...	...	270	0	0
Price of 12-horse Patent Double Cylinder Portable Engine	...	...	310	0	0

Screw Blocks for steadying the Engine, as shown between the wheels of the above, £1 10s. the set.

HOWARDS' PATENT DOUBLE SNATCH BLOCK.

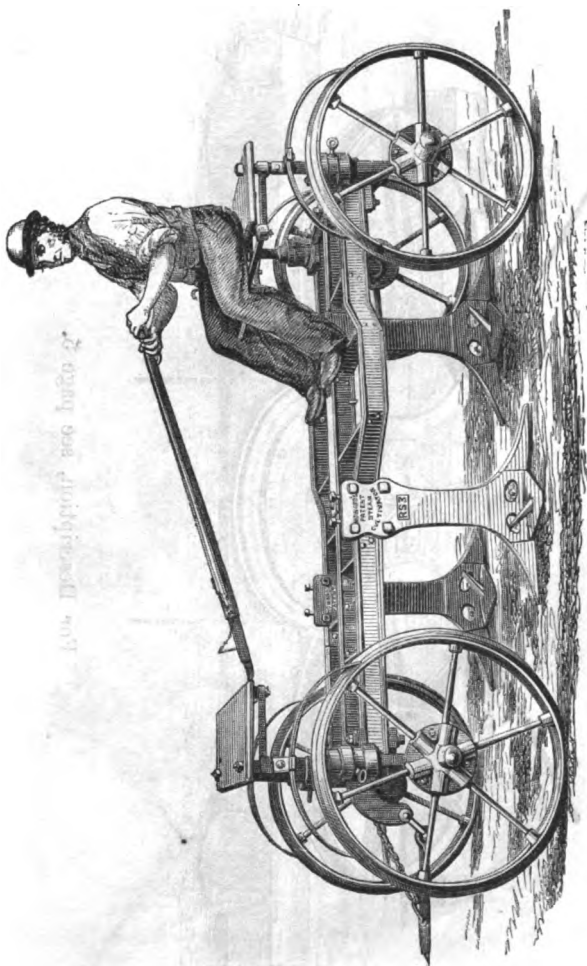


For Description, see page 5.

£ s. d.
12 0 0

Price

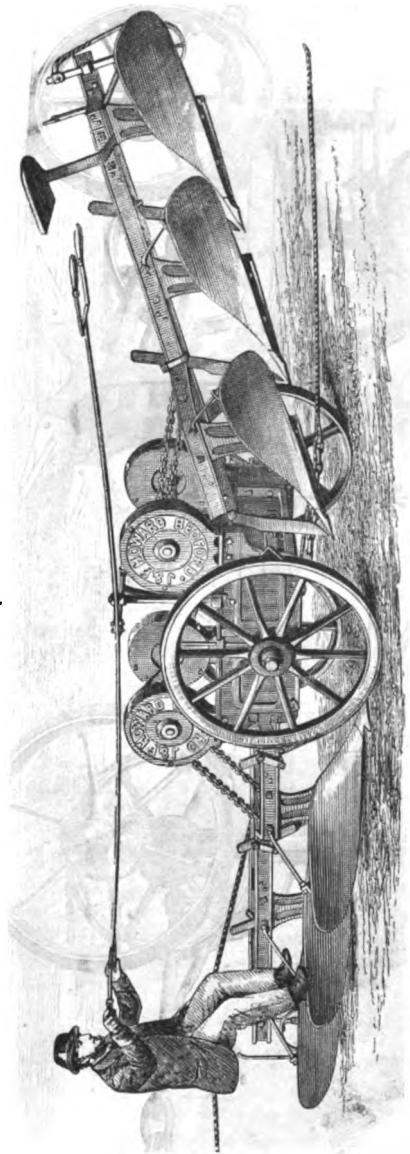
HOWARDS' PATENT DOUBLE-ACTION STEAM CULTIVATOR.



For Description, see page 5.

	£	s.	d.
Price, with three tines	21	0	0
Price, with five tines	25	0	0
Price, with seven tines, and extra strong steel beams for 14-horse engine	45	0	0
Price of a Side Harrow and fittings complete	3	10	0

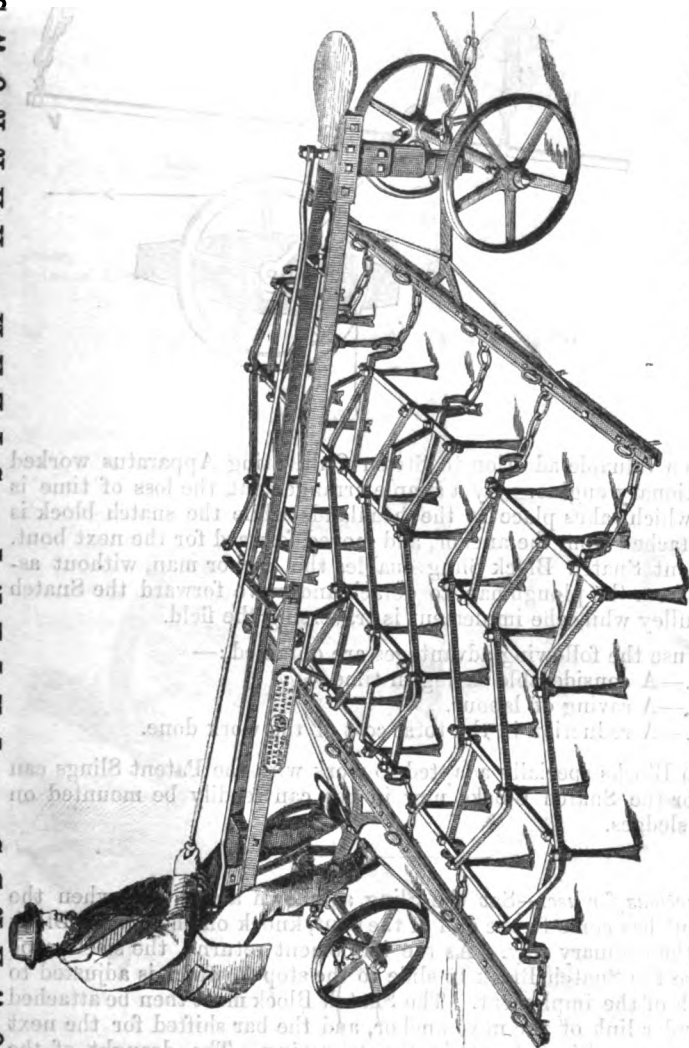
HOWARDS' PATENT DOUBLE-ACTION STEAM PLOUGH.



For Description, see page 5.

	£	s.	d.
Price, for two furrows	50	0	0
Price, for three furrows	65	0	0
Price, for four furrows	80	0	0

HOWARDS' PATENT STEAM HARROWS.

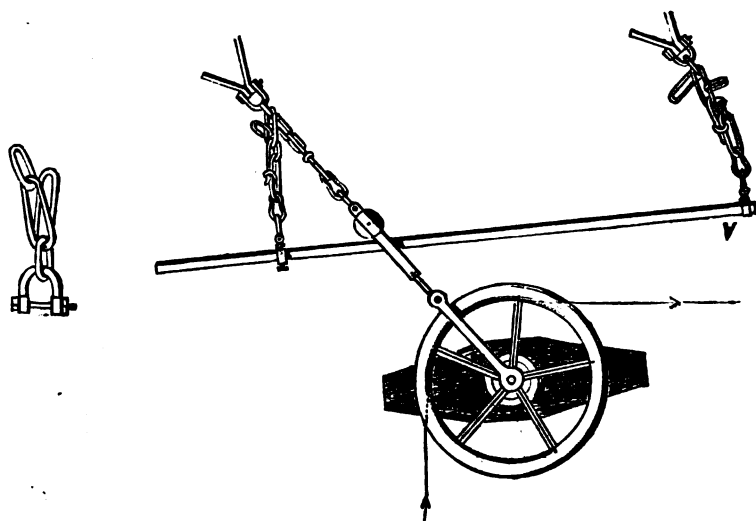


The **FIRST** and **ONLY PRIZE** for the best Harrows for Steam Power was awarded to J. & F. Howard, at the Newcastle Meeting of the Royal Agricultural Society of England.

For Description, see page 6.

Price of extra strong set, marked No. 1 ...
Price of lighter set, marked No. 2 ...

£ s. d.
23 10 0
20 0 0

BULSTRODE'S PATENT SNATCH BLOCK SLING.

This is a valuable addition to Steam Cultivating Apparatus worked by a stationary engine. By a simple arrangement the loss of time is avoided which takes place at the headlands while the snatch block is being detached from the anchor, and moved forward for the next bout. The Patent Snatch Block Sling enables the anchor man, without assistance from the ploughman, to detach and move forward the Snatch Block Pulley while the implement is traversing the field.

In its use the following advantages are obtained :—

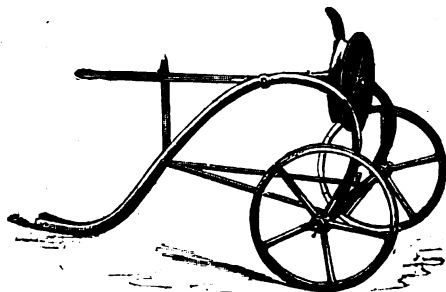
- 1.—A considerable saving in time.
- 2.—A saving of labour.
- 3.—A reduction in the total cost of the work done.

Snatch Blocks specially adapted to work with the Patent Slings can be had, or the Snatch Blocks now in use can readily be mounted on suitable sledges.

Instructions for use.—Set the Sling as shown above, and when the implement has come to the end of the bout, knock off the Snatch Block ring in the ordinary way. As the implement returns, the slack rope will cause the Snatch Block to slide to the stop A, which is adjusted to the width of the implement. The Snatch Block must then be attached to the under link of the next anchor, and the bar shifted for the next bout to the position shown in the engraving. The draught of the hauling rope must never depend upon the sliding bar, the tube not being intended to take any of the strain.

	£	s.	d.
Price of a pair of Patent Snatch Block Slings, complete	10	0	0
Price of a pair of Snatch Blocks, fitted with sledges to work with the above	6	10	0

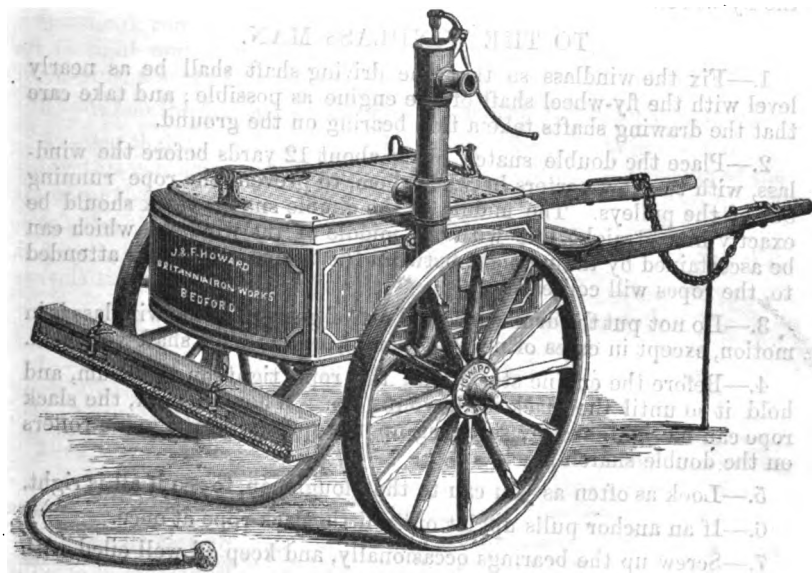
HOWARDS' PATENT LEVER ROPE PORTER.



For Description, see page 6.

	£	s.	d.
Price	...	1	10 0
Price of Three Wheel Porters	...	1	15 0

IMPROVED IRON WATER CARTS.



These Carts are intended for the supply of Engines used in Steam Cultivation, and they can also be used for the distribution of liquid manure, &c. The body of the cart is cast in one piece, and is more durable than either wrought-iron carts or cast-iron ones put together in pieces. The carts are self-balancing, and can be drawn by one horse. They contain 180 gallons, and are fitted with valves instead of taps, a great advantage in frosty weather.

	£	s.	d.
Price	...	20	0 0
Pump and Hose complete	...	5	0 0
Liquid Manure Distributor	...	2	0 0

INSTRUCTIONS FOR WORKING HOWARDS' PATENT STEAM CULTIVATING APPARATUS ON THE SINGLE ENGINE SYSTEM.

TO THE ENGINE DRIVER.

- 1.—Be sure that the engine stands firmly, and as nearly level as possible. If working with a connecting rod, place the engine and windlass so that the fly-wheel shafts shall be as nearly level and straight as you can get them.
- 2.—Whenever you can, set down the engine on the highest part of the field.
- 3.—Do not talk to any one whilst driving.
- 4.—Look very often at the ploughmen and anchor men.
- 5.—Slacken speed before the implement gets to the end of the land.
- 6.—If your engine has a single cylinder, a brake should be used to the fly-wheel.

TO THE WINDLASS MAN.

- 1.—Fix the windlass so that the driving shaft shall be as nearly level with the fly-wheel shaft of the engine as possible; and take care that the drawing shafts take a firm bearing on the ground.
- 2.—Place the double snatch block about 12 yards before the windlass, with two low porters between them, to prevent the rope running out of the pulleys. The middle of the double snatch block should be exactly in a straight line with the middle of the windlass, which can be ascertained by taking sight between the drums. If this is attended to, the ropes will coil easily.
- 3.—Do not put the drums into and out of gear while the windlass is in motion, except in cases of necessity, and keep the drum shaft well oiled.
- 4.—Before the engine starts, pull the rope tight on the drum, and hold it so until the slack is all wound up. When in work, the slack rope can be tightened by screwing up the springs of the guide-rollers on the double snatch block.
- 5.—Look as often as you can to the ploughman, to see if all is right.
- 6.—If an anchor pulls up, let out a little slack rope at once.
- 7.—Screw up the bearings occasionally, and keep all well oiled with the *best sperm oil*.
- 8.—As the windlass brakes wear, they can be raised by putting under them a thin piece of wood or leather.
- 9.—The ropes at the end of each season, and occasionally at other times, should be dressed over with a mixture of tallow and the best Stockholm tar (not gas tar).
- 10.—Take the ropes off, and turn them occasionally, and see that they do not get twisted; care should be used to put them on again *tight and true*; to this end, when putting on the ropes, let the implement into the ground enough to stretch the rope tight.

TO THE ANCHOR MAN.

- 1.—Lay your anchor at right angles to the rope, or in such a position that the strain is equal on both legs.
- 2.—Place your lever under the front and over the back bar of the anchor, and weigh upon it before the plough starts. .
- 3.—When the plough is working away from you, let your anchor well into the ground, so that it may get a good hold before the strain of the engine comes on to it.
- 4.—If you find the engine-driver is not stopping the plough in time, knock off the snatch block ring directly, so as to prevent the plough running into the anchor.
- 5.—Always keep an extra anchor ready in case of accident.
- 6.—In loose land, or hard work, use two anchors, placing one before the other, and uniting them with a connecting chain.

TO THE PLOUGHMAN.

- 1.—See that your attendants keep the rope well off the ground by the porters.
- 2.—Look round the plough at dinner time and each night, to see that all is tight and in working order; keep by you some extra washers, lynch-pins, wheels, and shares.
- 3.—When the ground is very hard, use narrow shares for breaking up.
- 4.—See that all the shares work the same depth. With the Cultivator, this can be ascertained by measuring from the under-side of the frame to the point of the share.
- 5.—See that the wheels are *well oiled* daily. Take them off weekly, and well scrape and clean both axles and wheels. Be careful that the swivels turn freely.

MANAGEMENT OF THE ROPE PORTERS.

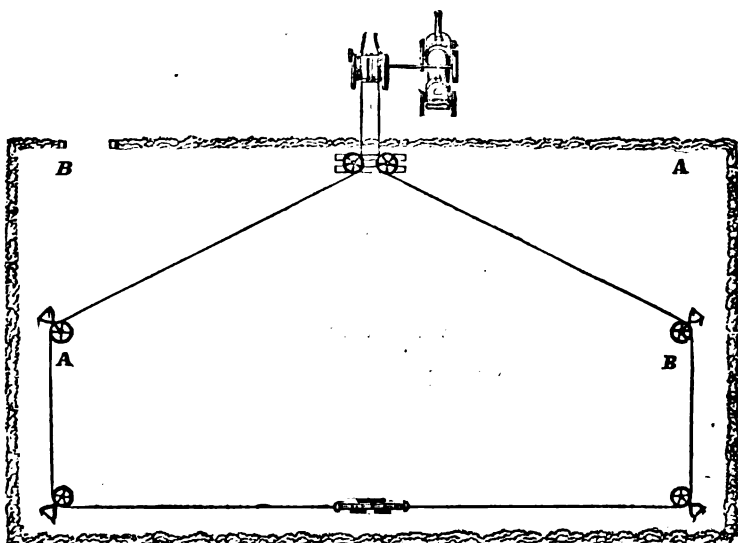
- 1.—Use the two-wheeled porters in the track of the implement, 30 yards apart, and work them by two boys, one to pull them out, and the other to replace them.
- 2.—Place the three-wheeled porters about 50 yards apart.
- 3.—Always place the rope porters on the highest ground; for instance, in crossing lands keep the porters on the ridges.
- 4.—When setting out the porters, strain each rope tightly, and adjust the porters to it before beginning to work.

SIGNALLING.

The best mode of signalling is for the ploughman to hold up the flag when about ten yards from the end of the land; the engine driver should then slacken speed. The flag should not be dropped until the end is reached. In foggy weather each man should use a signal whistle.

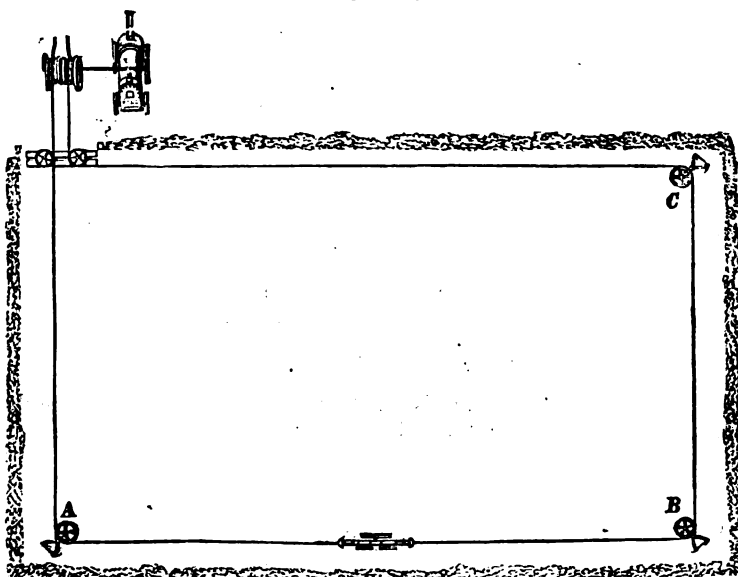
It is of the greatest importance that the above instructions should be strictly attended to, and that every part of the machinery should be kept clean and well oiled. Attention to these points will greatly add to the durability and efficiency of the whole apparatus.

PLANS FOR SETTING DOWN THE CULTIVATING
APPARATUS ON THE SINGLE ENGINE SYSTEM.



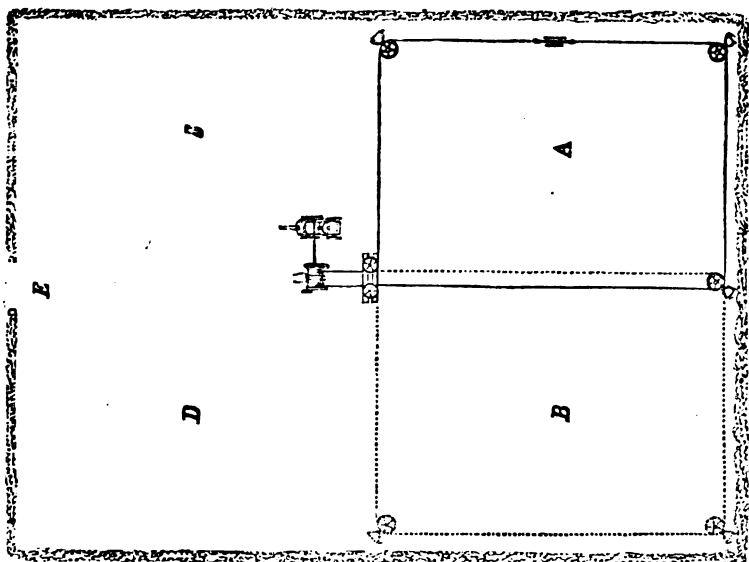
Fix the Engine in an adjoining field or road, and pass the ropes through the fence or a gateway. When the Cultivator has worked as far as A B, remove the pulleys to the corners marked B A.

PLAN TO COMPLETE A FIELD WITHOUT MOVING THE
ROPES.



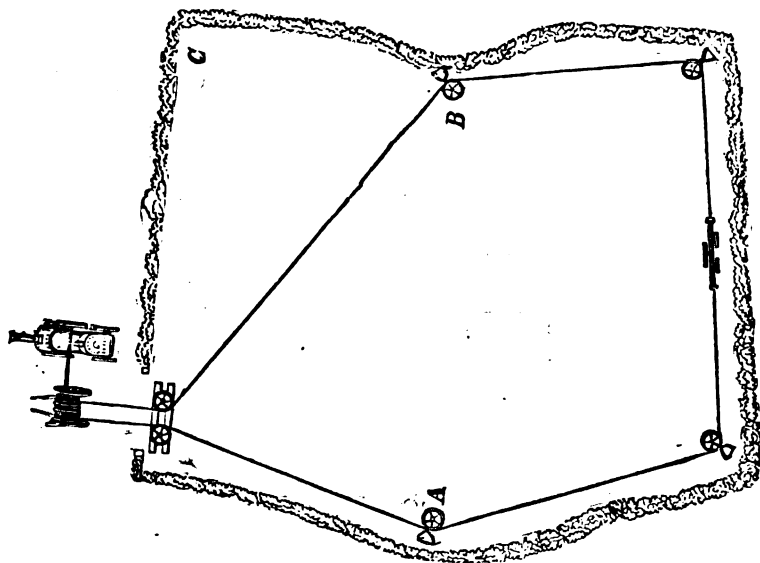
In this plan the implement may be worked either between A and B, or between B and C.

PLAN FOR VERY LARGE FIELDS.



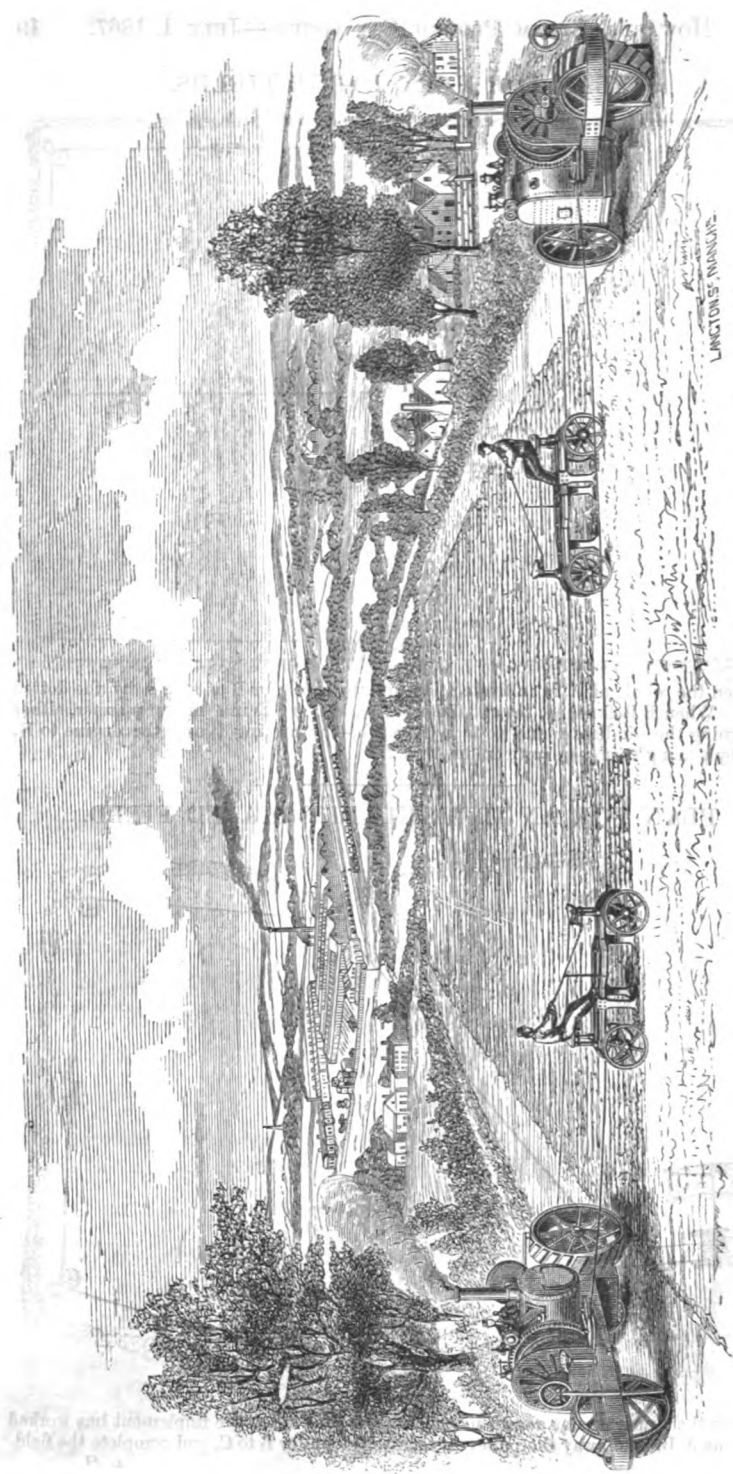
When the whole of A is cultivated, lay out the ropes for B as shown by the dotted lines. When B is finished, set out the other parts C and D in a similar manner, either by turning the windlass round to face the work,—by moving it and the engine to E,—or by placing them as shown in diagram 2.

PLAN FOR AN IRREGULARLY-SHAPED FIELD.



Place the Apparatus as shown in the diagram, and when the implement has worked as far as A B, take away the pulley A, remove the pulley B to C, and complete the field.

HOWARDS' STEAM CULTIVATING APPARATUS ON THE DOUBLE ENGINE SYSTEM.



Price of a pair of Fourteen-horse Engines, with Single Drums and Apparatus, complete as above, £1350.

Price of a pair of Fourteen-horse Engines, with Double Drums and two Cultivators, for working simultaneously on J. & F. Howard's newly patented method, £1550.

HOWARDS'

NEW PATENT

TRACTION

AND

PLOUGHING ENGINES.

J. & F. HOWARD'S New Patent Engines have been specially designed to meet the requirements of Steam Ploughing Companies and large occupiers, or for letting out on hire. They are, nevertheless, equally well adapted for general farm use, such as thrashing and grinding, or for sawing, pumping, and hauling heavy loads.

The general arrangement of these Engines is as simple as possible, and their construction is such as to insure durability; steel has been introduced in the working parts, where practicable, in order to combine strength and lightness.

J. & F. Howard have been long convinced that in an Engine intended for ploughing, the Boiler should be so arranged as not to be subject to great variation in the water level when ascending or descending steep inclines. The Editor of *The Engineer*, in a leading article published before the introduction of J. & F. Howard's Patent Engines, remarked upon Road Locomotives:—

“In ascending an incline with the fire-box behind, we drown the steam space in its most productive position, and descending we expose the crown of the fire-box to be burned. This question of Boilers, to get the best possible result on inclines, has to be yet further considered.”

If this be an evil in Road Locomotives, how much more serious is the objection when applied to a Ploughing Engine, which may for days together be slowly moving up or down hill, on an incline of 1 in 8, or 1 in 10, which would cause a difference of 12 inches in the boiler level, with its consequent results.

In J. & F. Howard's New Engines this evil has been entirely overcome, without altering the form or sacrificing the generally acknowledged advantages of the locomotive boiler; instead of placing it lengthwise, the boiler is simply placed *across* the framework. By this arrangement the water level on the steepest hill never varies sufficiently to leave any part of the fire-box or tubes uncovered, and another point of some importance is that the steam space is not diminished whatever the incline may be upon which the engine is working.

Another point of considerable importance as affecting durability is, that the boiler is entirely relieved from the strain or torsion of the heavy propelling or traction gear; the propelling gear, being enclosed or boxed in, is not liable to derangement from dirt or stones getting into the cogs, and the necessity of a pitch chain is also avoided.

The engines being mounted on three wheels stand steadier on unlevel ground, and the steerage being effected by locking the leading wheel, the engine is under perfect control, and may be turned round in its own length or upon an ordinary road.

The Double Engine system requires less rope, and where the fields are large and square, a greater breadth of land can be ploughed in a day than by perhaps any other arrangement, and less time is occupied in removing from field to field or place to place; they are, however, more adapted for letting for hire and for the great plains of foreign countries than for a Farmer's own use, unless his occupation be exceptionally large. In very hilly districts and awkwardly-shaped fields both Engines may remain stationary, and the ropes can be arranged as in J. & F. Howard's plan of working the ordinary portable Engines and fixed Windlass, or one Engine may remain stationary and the other move along the headland.

The Engines are also adapted for ploughing on the Single Engine system, being fitted with two winding drums conveniently arranged upon the framework: the whole Apparatus can be thus conveyed from field to field without the aid of horses, and the time occupied in setting down is reduced to less than one half, while the first cost is little more than that of an ordinary self-propelling Engine and a detached Windlass.

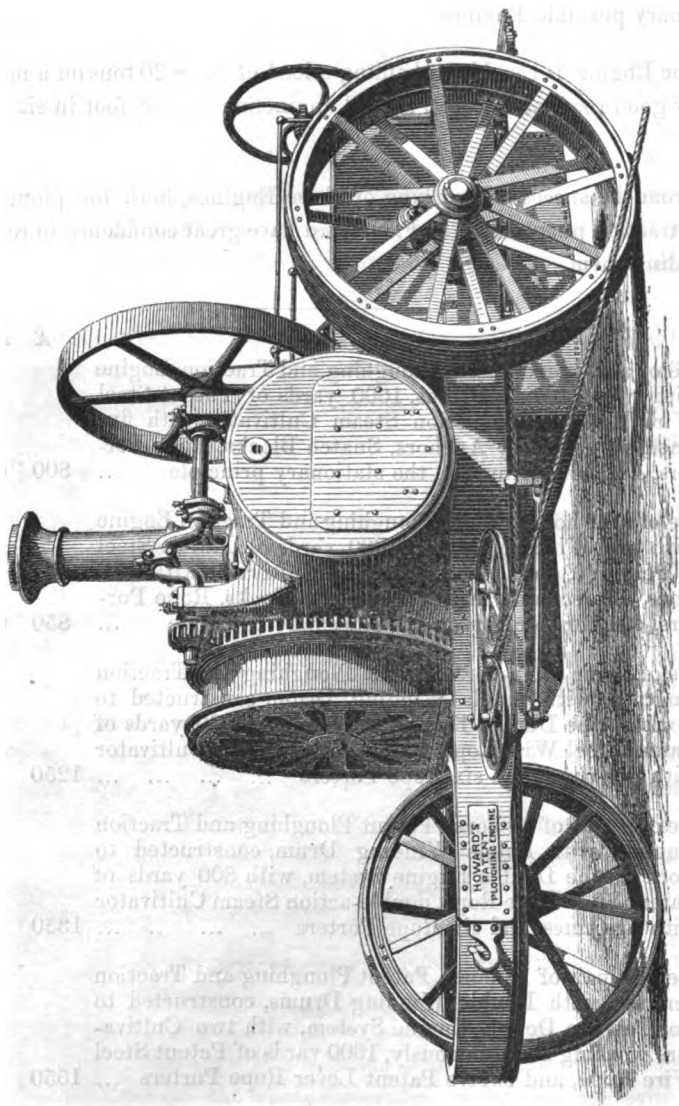
When the Engine is required for the ordinary work of a farm, such as thrashing, grinding, &c., or for sawing and pumping, the winding and traction gear are disconnected from the crank shaft, and the power can then be taken from the fly-wheel in the same manner as with ordinary portable Engines.

The Engine is capable of hauling a load of 20 or 30 tons on a moderately good road, and it can ascend an incline of one foot in six with ease.

From the successful working of these Engines, both for ploughing and traction purposes, J. & F. Howard have great confidence in recommending them.

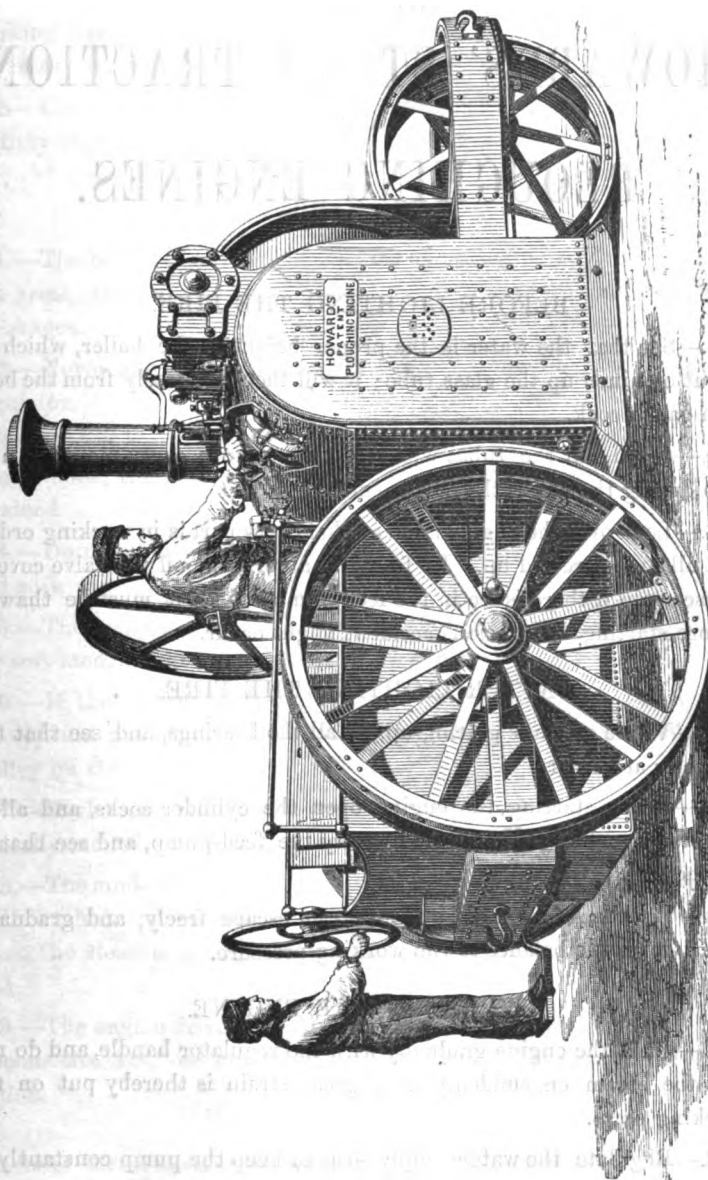
	£	s.	d.
Price of a 12-horse Patent Ploughing and Traction Engine with two Winding Drums, 1600 yards of Patent Steel Wire Rope, double-action Steam Cultivator with five tines, all necessary Anchors, Snatch Blocks, Rope Porters, &c., for working on the stationary principle ...	800	0	0
Price of a 14-horse Patent Ploughing and Traction Engine with two Winding Drums, 1600 yards of Patent Steel Wire Rope, double-action Steam Cultivator with five tines, all necessary Anchors, Snatch Blocks, Rope Porters, &c., for working on the stationary principle ...	850	0	0
Price of a pair of 12-horse Patent Ploughing and Traction Engines, with Single Winding Drum, constructed to work on the Double Engine System, with 800 yards of Patent Steel Wire Rope, double-action Steam Cultivator with five tines, and six Rope Porters	1250	0	0
Price of a pair of 14-horse Patent Ploughing and Traction Engines, with Single Winding Drum, constructed to work on the Double Engine System, with 800 yards of Patent Steel Wire Rope, double-action Steam Cultivator with five tines, and six Rope Porters	1350	0	0
Price of a pair of 14-horse Patent Ploughing and Traction Engines, with Double Winding Drums, constructed to work on the Double Engine System, with two Cultivators working simultaneously, 1600 yards of Patent Steel Wire Rope, and twelve Patent Lever Rope Porters ...	1550	0	0
Price of a 12-horse Patent Traction Engine, with broad wrought-iron wheels, but without Winding Drums ...	475	0	0
Price of a 14-horse Patent Traction Engine, with broad wrought iron wheels, but without Winding Drums ...	520	0	0

HOWARDS' NEW PATENT TRACTION AND PLOUGHING ENGINE.



For Description, see page 21.

HOWARDS' NEW PATENT TRACTION AND PLOUGHING ENGINE.



For Description, see page 21.

INSTRUCTIONS FOR WORKING HOWARDS' STEAM TRACTION AND PLOUGHING ENGINES.

BEFORE LIGHTING THE FIRE.

- 1.—See that the water is the proper height in the boiler, which is about one inch up the glass tube; it will then run freely from the bottom gauge cock.
- 2.—Clean out the tubes with the tube cleaner every morning, and also during the day if the coal is smoky.
- 3.—Look over the engine and see that every part is in working order, and all nuts screwed up. In frosty weather, take off the valve covers, to ascertain if there is ice in the feed pump; if so, it must be thawed before starting, or a serious accident might occur.

AFTER LIGHTING THE FIRE.

- 1.—While steam is getting up, oil all the bearings, and see that the oil holes are clear.
- 2.—Before starting the engine, open the cylinder cocks, and allow the steam to blow through freely; try the feed-pump, and see that it works well.
- 3.—Try the safety valve, and let steam escape freely, and gradually screw down the balance to the working pressure.

WORKING THE ENGINE.

- 1.—Start the engine gradually with the regulator handle, and do not put the steam on suddenly, as a great strain is thereby put on the working parts.
- 2.—Regulate the water supply so as to keep the pump constantly at work.
- 3.—Test the height of the water in the boiler frequently by the gauge cocks, as well as by the glass.

AFTER LEAVING OFF WORK.

1.—Blow off a portion of the water from the boiler every night, which will carry off a great deal of the sediment, then fill it up to the working level, which will run down the steam, and leave all ready for the next day.

2.—Clean down the engine, as it is much more easily done while hot. A dirty engine is a sure indication of neglect and a careless driver.

PRECAUTIONS.

1.—The best sperm oil or refined lard oil only must be used. Bad oil is a great cause of wear and tear, and its use often results in expensive breakages.

2.—Never start the engine with the reversing link, but with the regulator.

3.—Do not back the engine and then run at the work full speed. If this is done, the probability is that something will give way or be strained.

4.—Do not move the engines in the fields when the ground is wet and soft.

5.—The grappling irons, for occasional use on the wheels, are intended for soft land, and are not to be used on *planks* or a *hard road*.

6.—If the engine unavoidably sinks into a hole, first jack up the wheels and put planks under, and then haul it out by the rope and pulley on the main axle.

7.—If the lead plug on the crown of the fire-box leaks, or is accidentally melted, replace it by another *lead* one.

8.—The mud-hole lids should be taken out once a week, and the boiler well washed and cleaned out; but the water must not be blown off when the steam is up, as it causes the tubes and rivets of the boiler to leak.

9.—The engine driver should be provided with a copy of the "Road Locomotive Act," or an abridgment, which will be sent free on application.

It is of the greatest importance that the above Instructions should be strictly attended to, and that every part of the Engine should be kept clean and well oiled. Attention to these points will greatly add to its durability and efficiency.

LIST OF PURCHASERS IN GREAT BRITAIN
OF
STEAM CULTIVATING IMPLEMENTS,
MANUFACTURED BY
JAMES & FREDERICK HOWARD.

HER MAJESTY THE QUEEN, OSBORNE, ISLE OF WIGHT.

Bedfordshire.

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Mr. J. S. Crawley, Farley, Luton
Mr. Henry Keep, Carlton
Mr. William Lavender, Biddenham
Mr. Robert Long, Stondon, Biggleswade
Mr. Thomas Brightman, Little Staughton
Mr. William Pike, Stevington
Mr. J. C. Robinson, Stevington
Mr. Edward Turney, Souldrop
Mr. Charles Street, Cople
Mr. J. D. Squire, Crophill, Amptill
Mr. T. B. Kitchener, Potton
Mr. Edmund Powers, Tempsford
Rev. J. W. C. Campion, Westoning, Woburn
Mr. G. Hawkes, Arlsey

Berkshire.

Mr. J. Walter, Bearwood Farm, Wokingham
Mr. R. Benyon, M.P., Ufton, Reading
Mr. E. Pullen, Sutton Courtney, Abingdon
Mr. T. H. Simmons, Whitley, Reading
Mr. William Bulstrode, Cookham Dean, Maidenhead
Mr. J. Gillett, Highway Farm, Maidenhead
Mr. W. Holmes, Wargrave, Reading
Mr. James Williams, Shippon, Abingdon
Mr. John Hargreaves, Silwood Park, Sunningdale
Mr. E. Goodman, Oare, Pewsey

Buckinghamshire.

Baron de Rothschild, M.P., Mentmore, Tring
Sir Anthony de Rothschild, Bart., Aston Clinton, Tring
Mr. G. Baker, Loughton, Stony Stratford
Mr. F. W. Bignell, Loughton
Mr. Stephen Byers, Slapton, Tring
Mr. J. Nickson, Loughton, Stony Stratford
Mr. Thomas Revis, Olney
Mr. Henry S. Trowers, Castlethorpe, Stony Stratford
Mr. W. W. Thorne, Bishopstone, Aylesbury

Cambridgeshire.

Mr. William Fyson, Stuntney, Ely
Mr. J. L. King, Wood Ditton, Newmarket
Mr. Martin Pate, Ely
Mr. Robert Pate, Haddenham, Ely
Mr. A. S. Ruston, Chatteris, March
Mr. T. Richardson, Chatteris, March
Mr. G. O. Newton, Croxton Park, St. Neots

Cheshire.

Miss Edwards, Gib Hill, Warrington
Mr. J. Cattle, Marsh Farm, Sealand, Chester

Cornwall.

Mr. Joseph Lyle, Bonython, Helston

Cumberland.

Messrs. Carr & Co., Carlisle
Mr. Jenkinson, Cockermouth
Mr. John Norman, High Close, Aspatria

Dorsetshire.

Mr. C. Hawkins, Alton Pancras, Dorchester
Mr. H. Duke, Broad Mayne, Dorchester
Mr. Miles Rodgett, Sandford, Witham
F. Pope, Esq., Kingston Lacey, Wimborne

Essex.

Messrs. Bott & Impey, Broomfield, Chelmsford
Messrs. Blyth & Squier, Stanford-le-Hope, Romford
Mr. Joseph Bray, Pyrge Park, Romford
Mr. W. Scragg, Gt. Clacton, Colchester
Mr. Joseph Foster, Blunts Hall, Witham
Mr. J. Neill, Canewden Hall, Rochford, Chelmsford
Mr. C. W. Willsher, Petches Farm, Braintree
Mr. R. Harden, Rickling's Green, Bishop Stortford

Gloucestershire.

The Right Hon. Lord Sudeley, Toddington, Cheltenham
Dr. Hitch, Sandywell Park, Cheltenham
Mr. Surman, Swindon Hall, Cheltenham
Mr. H. Wilkins, Westbury-on-Severn
Messrs. R. T. & J. Witecomb, Pirton Court, Churchdown, Gloucester
Mr. T. Williams, Nass House, Lydney
Mr. Brain, Greet, Winchcomb, Cheltenham

Hampshire.

Mr. G. Young, Apley Towers, Ryde
Mr. J. Lancashire, Micheldever
Mr. J. W. Scott, Rotherfield Park, Alton
Mr. W. H. Stone, Leigh Park, Havant
Mr. A. Rosling, Droxford, Southampton

Herefordshire.

Mr. F. Drinkwater, Eaton Bishop, Hereford
Mr. Hawkins, Sugwas, Hereford
Mr. Thomas Davis, Linton, Ross
Mr. Felix Smith, Upton Bishop, Ross
Mr. Charles Brunson, Sutton, Hereford
Herefordshire Steam Cultivating Co.
(Limited), Hereford

Hertfordshire.

Mr. E. J. Davis, New Park Farm, Hertford
Mr. B. Nicholson, Much Hadham, Ware
Mr. John Smyth, Newsell's Bury, Royston
Mr. T. Willis Ginger, Kensworth, Dunstable

Huntingdonshire.

His Grace the Duke of Manchester, Kimbolton Castle
Colonel Linton, Buckden, Huntingdon
Messrs. Armstrong & Topham, Graffham
Mr. F. Battcock, Hemingford Abbots
Mr. W. Cranfield, Buckden, Huntingdon
Mr. R. Faux, Yaxley Lodge, Peterborough
Mr. T. Inskip, Fenstanton, St. Ives
Mr. W. Looker, Wyton, Huntingdon
Mr. J. Rust, Alconbury, Huntingdon
Mr. R. Barton, Wigan Farm, St. Ives
Mr. J. Mortlock, Pidley, Huntingdon
Mr. R. Daintree, Woolley, Kimbolton

Kent.

Mr. Davidson, Watlingtonbury, Maidstone
Mr. Punnett, Chart Sutton, Staplehurst
Mr. W. Gillow, Sandwich
Mr. J. Henderson, Shrubbery, Sandwich
Mr. Gascoyne, The Lawn, Sittingbourne
Mr. W. C. Morland, Lamberhurst
Mr. E. L. Betts, Aylesford Park, Maidstone
Mr. James Lake, Newlands, Sittingbourne
Mr. T. Piddlesden, New Romney, Folkestone
Mr. John Abbott, Ospringe Parsonage, Faversham
Mr. L. Latter, Leigh, Tunbridge
Messrs. J. & F. Cheesman, Boughton Malherbe, Maidstone
Mr. Thomas Lake, Tong, Sittingbourne
Mr. J. Mansfield, Raynham, Sittingbourne
Messrs. Blaxland & Martin, Westwood Court, Faversham

Lancashire.

Messrs. J. & D. Harrocks, Greenbank Farm, Toxteth Park, Liverpool

Leicestershire.

Lord A. St. Maur, Burton Hall, Loughboro'
Mr. Packe, M.P., Prestwold Farm, Loughborough
Mr. J. Broadhead, Twycross, Atherstone
Mr. J. Toone, High Cross, Lutterworth
Mr. G. E. Paget, Sutton Bonnington, Loughborough
Mr. T. Wilson, Knaptoft Hall, Market Harborough

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Mr. Dring, Sutton Marsh, Long Sutton
Mr. H. Hemsley, Harlaxton, Grantham
Mr. F. Sowerby, Aylesby, Grimsby
Mr. J. Sowerby, jun., Beelsby, Grimsby
Mr. L. Walker, Gedney Marsh, Long Sutton
Mr. B. Wass, Osgodby, Market Rasen
Mr. T. Howard, Winterton, Brigg
Mr. A. Partridge, Roxholm Hall, Sleaford
Messrs. J. & J. Monks, Belton Gorse, Grantham
Messrs. Marshall, Sons & Co., Gainsboro'
Mr. John Brown, South Owersby, Market Rasen
Mr. Robert Cartwright, Owersby, Market Rasen
Mr. R. F. Ealand, Potter Hanworth, Lincoln
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Middlesex.

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Rt. Hon. Lord Leonfield, Petworth House
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 Horsham

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 Rt. Hon. Earl of Caithness, Barrogill Castle,
 Thurso
 Rt. Hon. Lord Kinnaid, Rossie Priory,
 Inchture
 Colonel Hay, Dunse Castle, Dunse
 Mr. H. Houldsworth, Coltness, Motherwell
 Mr. G. Hope, Fenton Barns, Drem

Ireland.

Right Hon. Lord Longford, Killucan
 Mr. T. C. Trench, Millicent, Naas
 Mr. J. N. S. Wallis, Drishane Castle, Mill-
 street
 Mr. W. Malcomson, Tammore

Wales.

Hon. H. H. Tracy, Gregynog Hall, Newtown
 Mr. B. N. Hooper, Cowbridge
 Mr. V. Gosford, Tan-y-llan, Holywell
 Mr. J. Surridge, Cogan Hall, Cardiff

In addition to the above, J. & F. HOWARD have supplied large quantities of STEAM CULTIVATING MACHINERY to France, Belgium, Germany, Italy, Spain, Portugal, Greece, Turkey, Egypt, India, America, West Indies, Australia, New Zealand, and other parts of the world.

THE FOLLOWING
REPORTS OF THE COMMISSIONERS
APPOINTED BY THE
ROYAL AGRICULTURAL SOCIETY OF ENGLAND
TO INVESTIGATE THE STATE OF
STEAM CULTIVATION,
APPEARED IN THE JOURNAL OF THE SOCIETY,
1867.

BEDFORDSHIRE.

REV. J. W. C. CAMPION, WESTONING, WOBURN.

HEAVY LANDS.—Rev. J. W. C. Campion, of The Manor, Westoning, Woburn, occupying 500 acres arable, and the same area of grass—hilly land, consisting of stiff clay and strong loam—has worked a Howard set of tackle for four years. The 10-horse engine and apparatus were bought second-hand for about £500; the repairs are not stated, as they would form no guide to what might be looked for with new first-hand machinery. In Mr. Campion's fields, of about 30 acres each, the average day's work, including removals, is 7 to 8 acres cultivated. The five men and two boys cost 16s. a day; water-carting, 6s.; oil and grease, 2s.; coal, at 15s. per ton, including carriage, costs 15s. per day; and a removal, if done at once, takes 10 horses, which is accomplished and steam got up in four hours. The engine is employed "at other times" in thrashing, but the apparatus is never let out. The force of horses has been reduced from 22 before to 16 now.

Mr. Campion reports that the drainage has been rendered more effectual by the steam culture, but that he cannot feed-off roots any better than before. He has increased the acreage of his root-crop, and all his crops, "with the exception of the wheat crop," have been more productive.

Very few hindrances in work have been met with, and no stoppages when duplicates of the parts have been in possession.

BEDFORDSHIRE.

MR. JOHN HORRELL, STEVINGTON.

HEAVY LANDS.—Mr. John Horrell, of the Stevington Lodge Farm, near Bedford, succeeded Mr. Pike (who here began steam cultivation in the year 1857), and purchased the apparatus second-hand of Mr. Pike, in 1863. This consisted of a 10-horse power double-cylinder engine, with Howard's tackle the price not stated. After working it three seasons, his testimony is that

he has worn out about half a rope, and that the cost of repairs altogether averages £40 per annum. In the autumn of 1863 he broke up 38 acres for barley, 5 or 6 inches deep, by the 3-tined cultivator, in six days, including three shifts. A bean-stubble was smashed up for wheat, 5 or 6 inches deep, 13 acres twice over, making 26 acres in four days. An average day's work is 6 acres, and a removal takes 3 hours with 4 horses. In 1865, the summer tillage consisted of 100 acres, done in 20 days—that is, an average of 5 acres per day, removals included. The depth of work with the 30-inch wide cultivator was 7 to 8 inches; the autumn work was 127 acres in 25 days, at a depth of 4 to 5 inches. In both seasons a portion of the work was "crossing." Here we have 45 days' work and 227 acres done in a year on a farm which includes 307 acres arable (besides 150 of grass) of peculiarly stiff, stubborn clay soil, upon a subsoil of blue gault, some of it on steep hill-sides, and lying in fields averaging 30 acres in size—some of them enlarged purposely for steam culture. The engine is occupied in thrashing, grinding, and chaff-cutting 98 days in a year, or more than double the time that it is engaged in cultivation. The average consumption of coal per day, in 1865, was 12 cwts., at 18s. per ton; of oil, 3 pints,—say 12s. per day, or 2s. 5d. an acre for both. The wages of the 5 men and 2 boys come to about 13s. 6d. a day, and the water-cart 4s. a day—that is, 3s. 6d. per acre for both; ordinary labourers' wages being 11s. a week. Mr. Horrell gives his engine-man 1s., his windlass-man 4d., and his anchor-men 2d. a day extra (when steam cultivating), with a bonus of 6d. per acre for beer among all the hands. The daily working expenses, adding, say 7d. per acre for removals, will be about 6s. 6d. per acre. What is the charge due on the machinery we have not sufficient data for ascertaining; though the £40 for repairs is the most important item. The pecuniary experience of steam culture on this farm appears very similar to that of many others which we have more fully detailed.

The tackle is now used solely upon the farm; but has done contract work at 21s. per acre, cultivating twice over, the farmer finding coal and water, and bringing the machinery home. Mr. Horrell does not consider this profitable, because of being set to desperately bad pieces. The engine is occasionally let out to thrash for other people, at a charge of 3s. per hour.

Good public roads run alongside much of the land, and a grass-ride, 13 feet in width, runs through most of the fields which do not abut on these roads. The water-supply is in ponds in most of the fields. Mr. Horrell has not been tenant here sufficiently long to say much about changes and augmentations of cropping. The drainage, he says, is certainly rendered more effective by the steam tillage; but still the soil is too heavy for feeding off roots with sheep to advantage. Managing on the 4-course system, he keeps 10 horses, or 5 less than the farm employed prior to steam cultivation; and in general he "is very well satisfied with the apparatus."

BEDFORDSHIRE.

MESSRS. JAMES AND FREDERICK HOWARD, BEDFORD.

HEAVY LANDS.—It is not necessary here to relate the history of Messrs. Howards' reclamation and remodelling of the Clapham Park and Green Farms,

and their improvement of the Hoo Farm (all now classed together as "The Britannia Farms"), in the neighbourhood of Bedford. Clearing of forest-timber and underwood, abolition of old boundaries, throwing field to field and planting new fences, the formation of direct hard-metal roads in place of winding clay lanes or across newly-opened country, the deep underdrainage of heavy soil, the laying down of new grass and cleansing of old tillage-land, have all been executed here with an expedition and completeness which may well stand out as an example of what should be done, and how it should be done, to prepare an estate for the full development of steam cultivation. Ten miles of hedgerows have vanished before an army of workmen, all stubbing by the piece; and their removal has added just 10 acres to the area of Clapham Farm. Sound roadways enable the master-spirit of the tillage-work—the steam-engine—to perambulate where it will, uphill and down, in almost any weather, into any of the enclosures; and when there, though it is stationary with a windlass while working, it cultivates fields of 10, 20, 30, and up to 55½ acres, "at one setting down." The drainage of almost every field has been designed with a view to supply the engine, a pond or open tank at almost every site occupied by the engine during the tillage of the whole estate receiving the drain-water, retaining supplies at all seasons, and letting only the "overflow" pass away by the mains which ultimately conduct it to the Ouse. At the principal farmstead a reservoir has been excavated, containing half a million gallons, the cost of digging being £50.

The extent of arable is 445 acres, all heavy land. The Hoo Farm presents a deep staple, 10 to 14 inches in thickness, upon homogeneous clay. Yet, before steam culture was practised, there were but a few inches of staple soil; the difference, on digging in a field and upon the headland edge, where the deep work has not reached, being remarkable—the raw, tenacious, gaulty clay having been obviously changed by cultivation into a brown unctuous earth, at once perceptibly better to the feel. Although the old high-backed lands have been everywhere levelled over a 4-feet deep drainage, the whole of the fields are declared to drain well in the wettest of seasons; and we found nothing like sloppiness or sponginess, though we entered almost every field in wretchedly wet weather.

One set of tackle, of Messrs. Howard's own principle and manufacture, with a 10-horse-power double-cylinder engine, performs the heavy tillage labour of these farms, and is now limited to this work alone, not being let out on hire; while another portable engine is employed to do all the thrashing and other yard work. Thus the expenses of steam cultivation are not mixed up with those of any other operations; and the cost of repairs, &c., has been charged against the farms, on the same scale as they would be to a complete stranger, in order to make them a thorough test and example of the pecuniary as well as other aspects of the question. Mr. James Dickson, the farm-manager, has furnished us with the following "epitome" from his account books, giving the totals of three years' experience:—

	Acres.
The extent cultivated by steam has been	2751
Cultivated for neighbours	300
Harrowed by steam, 535 acres, equivalent to cultivating (half)	267
In three years	3318

The expenses for rope, repairs, and renewal of wearing parts have

amounted to £99 15s. 5d., or, say £33 per annum. Divided by the acreage, it comes to 7d. and a fraction per acre.

Interest, at 5 per cent. per annum on the cost price of £540, comes to £80 2s. in the three years, or a fraction under 6d. per acre.

Depreciation, at 5 per cent. per annum on the main portion of the engine and apparatus, but excluding rope and other wearing parts, say upon £440, amounts to £66 in the three years, or a fraction over 4½d. per acre. The three items of repairs, interest, and depreciation, make a total of about 1s. 6d. per acre.

We must remark here, however, that any heavy repair, such as a new fire-box next year, would materially increase this very low average, derived from an experience of three years.

To get at the total cost of any given operation, according to this statement, we have only to ascertain the daily working expenses and the number of acres done per day. Mr. Dickson gives them as follows:—

	£	s.	d.
Engine-driver	0	2	8
Four labourers, at 2s. 3d.	0	9	0
Two porter-boys, at 10d.	0	1	8
One boy carrying water (no water-cart being used)	0	0	10
One day's manual labour	0	14	2
Coal (for 11 acres per day of 10 hours, a rate of work to be mentioned presently), 15 cwt. at 14s. per ton, with carriage, 2s. 6d.	0	13	0
Oil, one penny per acre on 11 acres	0	0	11
Repairs and renewal of rope and wearing parts, at 7d. per acre	0	6	5
Total working expenses per day	1	14	6
Or 3s. 1½d. per acre.			
Add—Interest, 6d. per acre	0	5	6
Depreciation, at 5d. per acre	0	4	7
Total outlay per day	2	4	7
Or a fraction over 4s. per acre.			

Mr. Dickson states that, on their very heavy clay soil, the cultivator, taking 3 feet breadth and smashing up the land 6 to 8 inches deep, and travelling at the pace of 3 miles an hour, requires a pressure of 80 lbs. in the double-cylinder 10-horse power engine. There is "regularly on the move" by the cultivator from 6 to 8 cwt. of soil, the shares cutting 3 feet of width, while it is 4 feet from the foremost point to the heel of the hindmost share—the weight of soil in a square yard, 6 inches deep, being 4 cwt. 3 qrs. 14 lbs. At this width, depth, and length, the rate of performance for a full day of 12 hours, is 11 acres. The ordinary average of work, we were informed, was 6 to 8 acres a day (we suppose including removals), from 6 to as much as 10 inches deep—the steam working at a pressure of 50 to 70 lbs., with a consumption of 9 to 13 cwt. of coal. The manager's statement refers to their highest speed, with a greater pressure and more fuel burnt. In his figures, too, he has forgotten the cost of removals, which must be allowed for, if we would get at an average instead of a full day's work. The shifting, we were told, is done by help of 7 horses (4 horses, except for great distances), and takes 2½ hours. The engine, when uninterruptedly at work, has to be moved about twice a week; so that we may add say 2s. 5d. a day to the total daily outlay, making £2 7s. per day. Dividing this by the lower average of 8 acres per day, the total cost of a first smashing up (with-

out including cross-cultivating or harrowing) is within a trifle of 6s. per acre. Undoubtedly, heavier repairs during the next three years will tend to raise these figures, which, as they are, certainly speak well in favour of steam cultivation. In fact, the cost is "a mere nothing" compared with the "value received;" the deep tillage of strong land is not accomplished by horses for as little as twice the cost here incurred by steam.

We saw the apparatus at work, deeply breaking up a stiff piece of bean stubble with excellent effect, though the rains had at that time (September 13th) hindered most people wherever we went from bringing out their steam-cultivators at all.* We need not describe Messrs. Howard's windlass, compensating double-snatch-blocks, two-way cultivator, rope-porters, anchors, etc.; but one feature in the apparatus struck our attention as a great improvement upon the old method of shifting the anchor-pulleys. This was the "Bulstrode" sling, by means of which the pulley, mounted on a boat-shaped block of wood, slides from one anchor to another, effecting a considerable economy of time. We observed that only 7 or 8 seconds elapsed between the implement stopping at the end and starting again. The headlands are 7 or 8 yards wide, and the practice is sometimes to finish off these by horse-labour, sometimes to break them up by steam before setting to work upon the surface of the field—the same plan is sometimes pursued with horse-grubbers not lifted out of the ground for turning.

Our remarks upon the farms in general were that everything seemed well done, and that the ground was very free from root-weeds and "vegetation:" the mangolds were particularly good and very clean. One splendid field of mangolds had been grown without farmyard manure, the artificial dressing being 5 cwts. of guano and 5 cwts. of salt. This was one of the few first-class crops we saw in all our journey. We must also compliment Messrs. Howard upon their magnificent swedes and turnips, upon rather kinder land than the majority of their property, though this particular piece has not been at present drained. One piece of yellow turnips, or newly broken-up land, was patchy and defective; while a portion of the same field, which had been longer under cultivation, bore an exceedingly good crop of the same roots, put in at the same time and in the same way. The stubbles everywhere showed well—the heaviest wheat being after potatoes, and sown in a steam-cultivated seed-bed.

We have remarked in our tour how few employers of steam-apparatus adopt a new system of culture along with the new power. In many, or rather in most cases, the rotation of crops is altered; but in comparatively few instances (which will be found in the course of our Report) did we find anything like so great a change in the tillage operations themselves as prominent advocates of steam culture have recommended—or a revolution in husbandry like that exemplified with extraordinary success, though in a small way, at Woolston. Mr. Bignell's practice of grubbing and trenching, in place of ploughing, is one great deviation from the time-honoured track: here, on the Britannia Farms, we have it on a more important scale. Scarcely any horse turn-over ploughing is done; nor is the

* This field has not been touched since, and, notwithstanding the wet season, it is now a nut-brown, mellow tilth, "like an ash-heap," ready to be drilled with barley after no other preparation than harrowing.—F. H.

steam tillage limited to smashing up stubbles, or the turn-over ploughing of leas. And from the practice here we learn how mistaken is the view that a steam-cultivating tackle is to be used merely (or even mainly) as a supplementary assistant to the farm-team, and general forwarder of the heavy work of a farm. In fact, in the course of our journeys, we gradually came to classify (in our own minds) the users of steam-apparatus according as they looked upon it as an "auxiliary" to horses, or as "the slave of the farm;" and when we lighted upon a man using his engine only to clean stubbles in autumn, and occasionally to "cross" again in spring, upon such land as we had seen made into seed-beds for almost all crops by men of larger insight into the powers of steam, we called it a case of "steam culture made easy to small minds." How did Messrs. Howard prepare for their mangold crop? The wheat-stubble was not smashed up and then left for horse tillage in spring, but at once ridged by steam—the ridges 27 inches wide; this being done by a double-breasted plough-body fixed in the cultivator-frame, in place of the tines, while a subsoiling tine on the same implement rooted up the bottom of the open trenches, the ridging and subsoiling being accomplished in one operation. This lay all the winter for the frosts and weather to make into the finest tilth imaginable; and in spring, manure was applied, the ridges were torn down by a cross cultivation by steam, and the seed-bed was ready for the mangolds. Of course the ground must be clean to admit of cheap, quick tillage like this. Another field was done as follows:—The oat-stubble was forked over by hand to get out tufts of couch, farmyard manure was applied, then the steam-cultivator smashed up the field, and after lying some time, the rough fallow was ridged into 27-inch wide ridges (or "drills") by horses. In spring came a cross-cultivation by steam, the land was harrowed, and the mangold-seed drilled in. Messrs. Howard steam-grub their clover-leas for wheat, doing this in the summer, early enough for the land to get sufficiently firm at bottom before sowing time comes; finding that, when this point is attended to, the wheat-roots do not meet with the hollow bottom so difficult to be avoided except by first-rate and closely-tucked ploughing. In fact, this work being done in June and July makes a "bastard fallow."

BEDFORDSHIRE.

MR. J. C. ROBINSON, STEVINGTON, NEAR BEDFORD.

HEAVY LAND.—Mr. J. C. Robinson, of Stevington, near Bedford, occupies 400 acres arable, with 200 acres of pasture; part of the surface flat, some very hilly; the soil generally a very heavy clay indeed, and the subsoil gault or drift chalk-stone. The fields range in size from 5 to 42 acres, and have been slightly altered in figure to make way for steam culture; but the two or three smallest inclosures are still worked only by horses. A practical instance, this, of the necessity for providing fields with enough elbow-room in them for the new motive-power. Good road facilities already existed, so that no expense has been incurred in laying out new ones.

Mr. Robinson's experience extends over seven years. He worked a Smith's cultivator for three years, and then, seeing that his neighbour, Mr. Pike (he says), could "break up his land and form a good seed-bed by once

going over" with a Howard cultivator, whilst he "was obliged to go twice over his land," he purchased the Bedford implement. The 8-horse engine cost £255, and the apparatus £250, everything included; that is, £505. The repairs of the apparatus have been "a new rope, a few years back, costing £66, four or five snatch-blocks, and a few rope-porters,—say £100 altogether." The repairs of the engine have been between £30 and £40; but Mr. Robinson says that, as "the engine does more other work by far than cultivating," he "cannot put above one-third of cost of engine repairs to the cultivating." The number of acres cultivated in a year is not stated; but this proportionate division of these repairs is evidently justifiable when we know that the tackle is used solely upon this farm of 400 acres arable, while Mr. Robinson states that the engine is used to thrash the corn of 1000 acres in each year, and he also employs it about one day in a fortnight to grind corn and cut chaff. The "repairs," then, due to the steam cultivation of a 400-acre farm, during more than half a dozen years, have been about £112: to which we may probably add a few pounds for light repairs done by the blacksmith. The whole of the maintenance may have cost, say £20 a year; the interest upon the cost price of the apparatus £250, and upon one-third that of the engine £85, or £335, at 5 per cent. is £16 15s.; the depreciation, at the same rate upon the same sum, minus the cost of the original rope and wearing parts, say upon £250, is £12 10s.; amounting altogether to £49 5s., which is the whole yearly cost of the machinery for cultivating the 400-acre heavy-land farm. This in itself is a valuable piece of evidence, although we have not the data for making a calculation of the expense per day's work or per acre; because it tells the practical farmer of a similar occupation, that investing capital in such an apparatus will be little more serious than keeping an extra horse, with all the outgoings that belong to him. Whether the actual working expenses make the steam-horse dear or profitable is very easily arrived at. Five men and two boys are employed, nearly always by the acre, getting 2s. to 3s. per acre, "and beer." Of coal, costing 18s. 6d. per ton, 7 cwt. per day is the common consumption; though 9 or 10 cwt. have been burned upon very hard work. As the acreage cultivated is 5 to 7 acres per day, "more when the weather is favourable," the coal costs on an average say 1s. 6d. an acre. Oil is probably a matter of 2d. an acre. The engine drinks four one-horse-loads of water per day; say at a cost of 6d. an acre. Removal every third day or so with the steam hands and 8 or 9 horses, occupying two hours, if to an adjoining field—a much longer time if to a distance, or if with fewer horses—will cost, say about 2s. 6d. per day, or about 4d. per acre. The whole working expenses thus amount to about 5s. 9d. per acre. Can this be otherwise than wonderfully cheap; "very heavy clay, indeed," steam cultivated for 5s. 9d. an acre, together with a yearly sum equivalent to little more than the expense that would be involved by an additional cart-horse? It cannot exceed what the cost of horse-power tillage would have been: probably it does not much exceed half, though, not knowing the annual acreage steam-cultivated, we cannot positively say. But while Mr. Robinson has obviously got into no heavy yearly outlay greater than he had before adopting steam culture, look at what he is realizing as actual saving and profit. The farm-team was 20 horses: seven years' experience warrants him in keeping only 14 now; and the banishment of six horses from the farm, with a saving of

£44 each, lessens the yearly outgoings by £264. And this is a small item in the gain; for Mr. Robinson has been enabled by the steam power to substitute beans and tares, or other green crops, for bare fallows; he has not increased the acreage of his roots, but he "has them better;" while he "thinks the crops generally have been better," which he attributes to "more work being done in dry weather in early autumn." Of course, he gets this yield-bringing early work done, because 6 horses, that could turn over at most one acre and a half in a day, have quitted the field for a machine that rives up and shatters to pieces a deeper staple at the rate of four or five times that acreage in a day; or, in other words, which accomplishes the work not of 6, but of 24 to 30 horses. For the comparison should not be between horse-grubbing and steam-grubbing, but between horse-ploughing and steam-grubbing that is still more effectual.

On the subject of a resultant better drainage, Mr. Robinson says, "I think clay-land should never be moved at all only when dry; but a farmer cannot afford to keep horses to do it while in that state. If the top is moved dry, the air will go far into the subsoil, and where the dry air goes the water will follow, and very quickly be down to the drains: the drainage, therefore, must be rendered more effectual by the steam-cultivation." As to any extra facility for feeding off root-crops, he says, "clay-land worked in this dry state, with a good manure, would grow the best quality of roots; but I think the better you have got your tilth by cultivating, the deeper the sheep would tread into the land, and partly undo what you have done. I cart half off, that is, the biggest and best, eating the remainder on the land."

BERKSHIRE.

MR. WILLIAM BULSTRODE, OF MOUNT FARM, COOKHAM DEAN,
NEAR MAIDENHEAD.

HEAVY LANDS.—Mr. William Bulstrode, occupying 300 acres arable and 60 of pasture,—is partner in a steam-tackle with a neighbour, Mr. J. M. Gurney, of Pinkneys Farm, Cookham, holding a farm of similar size. The surface undulates, being in some parts rather "hilly;" and the fields range from 6 to 60 acres each, with no alterations of fences, or roads made for the accommodation of steam-power. A portion of the land consists of sharp gravel, part of loam on a chalk subsoil, and part of very stiff clay.

In May, 1861, a Clayton and Shuttleworth's 10-horse power double-cylinder portable engine was purchased, at a cost of £300; with a Howard tackle,—including Windlass, 1760 yards of steel rope, 5-tined cultivator, a set of drag-harrows, 10 extra porters, 4 extra snatch-blocks, and 4 extra anchors,—which cost £253 10s.; thus the whole investment was £553 10s. During the first two years the apparatus was let out on hire; but this practice was abandoned, owing to the excessive wear and tear involved in travelling about, and in being put to the worst pieces of work that farmers had to do. Hence, the repairs have been greater than they would have been if the tillage of the two farms alone had been adhered to. In five years, the cost for repairs to porters, snatch-blocks, windlass, engine, etc., amounted to £100, or £20 a year. The smaller repairs

are executed by a smith and iron-founder at Maidenhead; but duplicates of parts most liable to break are generally kept on hand, so that the accidental hindrances to working have been merely nominal. The principal breakages which have occurred are these:—bursting off windlass drum flanges, and breaking the windlass-pinion cogs, which parts are now made stronger. Snatch-blocks, too, were at first broken through careless mismanagement, which hardly ever happens now: breaking of the rope sometimes occurs—depending partly upon the management and partly upon the quality of the rope. The destruction of rope is an item not easily determined. In February, 1864, a length of 1400 yards of new rope was purchased; but 600 yards of the old were still kept in use, and are working now. It would appear that (1760–600) 1160 yards of rope were destroyed in the first three years. Of the total length purchased, namely (1760+1400) 3160 yards, the remaining 2000 yards are still so good that Mr. Bulstrode does not expect to want any new rope for one or two years to come.

Up to May, 1866 (that is, five years' work), 2137 acres had been cultivated, at an average depth of 8 inches, and greatest depth 13 inches, and 464 acres had been drag-harrowed; and if we take 2 acres of this harrowing as work equivalent to one acre of the grubbing, the total acreage may be stated at 2369 acres. Upon this performance the wear of rope has been 1160 yards worn out, *plus* a proportion of damage to the 2000 yards remaining. If we may say, one-half the use of the 2000 yards is chargeable upon the five years work, the 2369 acres of work will have consumed (1160+1000) 2160 yards of rope, which, costing £94, makes the sum per acre about 9½*d.* However, Mr. Bulstrode says, "The wear and tear of rope, when I first had it, was fearfully great, owing to the tackle being out on hire; I therefore think that, for home work, and with proper care, a charge of 6*d.* per acre for rope will about cover the cost." Repairs (£100) at 10*d.* per acre, and rope at 6*d.* to 9½*d.* per acre, will together amount to 1*s.* 4*d.* or 1*s.* 7½*d.* per acre.

The engine being employed to do the farm thrashing, an allowance must be made in calculating interest and depreciation. Let us take interest at 5 per cent., on say £450, and depreciation at 5 per cent., on say £350; this will be, for the two items, in five years, £200, or 1*s.* 8*d.* per acre. Thus the cost due to the machinery (including rope and repairs) will be 3*s.* to 3*s.* 3½*d.* per acre.

Next, as to working expenses. All the hands are ordinary farm-labourers, and ordinary wages are 12*s.* a week. But the steam hands work 11½ hours a day (it being folly to run short days with an expensive apparatus that requires no rest); the engine-man, too, having 1½ hour to spend in getting up steam. The engine-man is paid 3*s.* a day; ploughmen and windlass-men, 2*s.* 6*d.* each; two anchor-men, 2*s.* 3*d.* each; two porter-men (not boys), 2*s.* 3*d.* each (though in short fields one porter-man is sufficient): and one man with the water-cart, and engaged in oiling, etc., 2*s.* 3*d.*, or 19*s.* 3*d.* altogether. Then, each man has 3 pints of beer, or 3 gallons for the gang, at 2*s.* 6*d.*; making the total labour per day £1 1*s.* 9*d.* The horse, carting about 900 gallons of water from a spring at the homestead, costs 2*s.* 6*d.* Moving takes 8 horses, and the regular steam hands, for two hours; or sometimes 4 horses for a longer time, generally about every third day—say, the cost of horses, 1*s.* 9*d.* upon each working day. Two pints of oil

cost 1s. 3d.; and 11 cwts. of coal, at 18s. a ton, cost 9s. 11d. per day. The expenses are thus £1 17s. 2d. per day.

Howards' cultivator, generally taking about 3 feet breadth, will take more than 4 feet breadth when the 5-times are worked with wide shares on; and with an average depth of work, 8 inches (the greatest depth is 13 inches), and the engine moving with 60 lbs. pressure, it does 9 acres a day. The drag-harrows (two being generally used), under their exceedingly light steerage-frames, accomplish 20 acres per day on an average. The following are the particulars in Mr. Bulstrode's "steam-cultivating journal":—

"Summary of work done in 1865—

	Acres.
Cultivated, first time	102½
" second time	179
Drag-harrowed by steam	48
Total	329½

Number of removals 16

Number of days' work 40

Therefore the number of acres per day, including removals $\frac{329\frac{1}{2}}{40} = 8\frac{1}{4}$."

"The summary of spring work done in 1866, is—

	Acres.
Cultivated (but not first time)	133
Drag-harrowed by steam	91½
Total	224½

Number of removals (including the first setting-down)... 8

Number of days' work (including removals) 24

Therefore the number of acres per day, including removals is $\frac{224}{24} = 9\frac{1}{3}$ acres.

And the number of acres per day, exclusive of removals, is $\frac{224}{22} = 10\frac{1}{4}$ acres."

When we know that during part of the year 1865, Mr. Bulstrode had not adopted certain improvements (to be mentioned presently) which now accelerate his speed of working; and that some time was taken up in experimenting upon the said inventions, we may fairly put the present rate of performance (including the breaking up of whole ground as well as spring crossing) at an average of 9 acres per day. Hence, the average cost of the steam-work is 4s. 1½d. per acre for working expenses, and 3s. to 3s. 3½d. per acre for the machinery, making a total of 7s. 1½d. to 7s. 5d. per acre.

To put the pecuniary statement of the case in another way: the apparatus was engaged for 79 days in 1861; 87 days in 1862; 46 in 1863; 68 in 1864; 40 in 1865; and 24 up to June, 1866—being much hindered by wet weather in the spring of 1866, but not much in the other years. But on Mr. Bulstrode's own farm the average number of days' work is 35 days of cultivating, and 4 of drag-harrowing, or 39 days per year. The working expenses being £1 17s. 2d. per day, the yearly outlay will be £72 9s. 6d. Add interest and depreciation, £40; repairs, £20; and rope (£94 for 5 years ÷ 5) £18 16s., and we have the total annual outlay upon steam tillage, £151 5s. 6d. Mr. Bulstrode has reduced his teams from 13 to 8 horses the displacement of 5 horses, at £44 each, saving £220 a year.

Mr. Bulstrode's neighbour (having worked the tackle only in autumn, at

least not in spring) has sold off only 3 horses, so that the total annual saving in draft animals effected by the steam tackle is 8 horses at £44; or £352. The whole yearly outlay being £151, the nett gain must be £201.

This is not a small gain, when we consider that it is saved not merely with the same tillage as before, but that the staple soil is now regularly worked to a depth of 8, instead of 5 inches.

Mr. Bulstrode has not altered the course of cropping upon his farm, which included one-fifth under roots; but he reports a larger produce from steam cultivation, partly due to increased depth of tillage; chiefly, however, to greater cleanliness of the ground. His practice generally is to stir land four times in preparation for a root-crop, and the firm is in a tidy condition.

A word or two must be said upon the partnership in the steam apparatus. The arrangement is this:—all expenses for repairs are divided equally between the two partners; a certain sum is agreed to, to be charged daily for wear and tear (say at 20 per cent. per annum on prime cost), and whoever works the tackle the greater number of days is charged that sum multiplied by the difference in the number of days.

Mr. Bulstrode has turned his mechanical taste to good account in expediting the action of his machinery. And his several ingenious appliances, though apparently small in themselves, so materially affect the results in the two important matters of "work done per day," and "cost of repairs per acre," that they are worthy the serious attention of all persons employing the stationary-engine system. Perceiving that a large percentage of time was lost every day in the mere delay of the implement at each end of the field, he devised the "patent snatch-block slings," which require no further description from us in this place than the intimation of their use and purpose. Instead of being knocked-off from one anchor, and, with difficulty to the anchor-man, hooked-on to the next, the patent pulley slides of its own accord along a strong iron bar to its place at the next anchor, and does this not while the implement is waiting at the end, but while the implement is in work on its way back again. In our account of Messrs. Howard's farm we record that only 7 or 8 seconds were observed by us to be spent between pulling-up the cultivator and starting it again, by help of these slings; this was when worked by Messrs. Howard's skilful men. Mr. Bulstrode's labourers we timed to be from 9 to 12 seconds in "turning at the ends." Mr. Bulstrode has drawn up the following comparison between this and the practice with the old pulleys:—

"1st. Nine acres can be cultivated per day, where only 8 acres could be done previously;

	Seconds.
Say, the average time of traversing a field is 2½ minutes ...	165
Average stoppage at the ends was	35
Total	200

The average stoppage when the sling is used is 10 seconds; and the time saved at each end is $35 - 10 = 25$ seconds. And as $25 : 200 :: 1 : 8$, therefore $\frac{1}{8}$ th of the whole time is saved. Or, in other words, 9 acres are done in the same time as 8 previously.

"2nd. The saving in labour in the cost of porter-men—no longer required to assist the anchor-men—may be fairly put at 2s. per day.

"3rd. The reduction in cost will amount to £40 per annum on a farm of average size. In this way, if the previous cost of cultivating per day was 50s., the cost per day with the slings will be 48s. The previous number of acres per day having been 8, the number of acres with the slings will be 9. Hence—

	s.	s.	d.
The cost per acre, without slings, is	9	=	6 3
The cost per acre, with slings, is	4	=	5 4
Saving per acre	...	...	0 11

Say, saving 1s. per acre, or 8s. per day. On a farm providing 100 days' work, or 800 acres of steam tillage in a year, the saving is £40."

We commend this little bit of arithmetic to occupiers of small fields, and ask them how they can possibly get the full profit out of a steam-apparatus until their landlords enable them to grub-up the hedgerows now preventing the implement from making 400-yard-long instead of 200-yard-long furrows. For if it be so important to shorten the time spent in "turning," how much more important it must be to lessen the number of "turnings" required in a day. Even Mr. Bulstrode's "10 seconds" at the end are one-tenth of the time occupied by a journey of the implement; that is, out of 11 hours in the day, one whole hour is lost in making the tool ready for its actual work. Suppose, now, his average field to be doubled in length, stoppage at the ends would be only one-twentieth of the whole time, and another half-hour's work, or nearly half an acre more, would be won in the day without the expenditure of another halfpenny in expenses. But on the other hand, if the field were of half the length of Mr. Bulstrode's field, then the number of turnings would be double, the time wasted would be one-fifth, or more than two whole hours out of the day, with more than one acre less done per day; or, in other words, the work would cost probably a shilling or 1s. 6d. per acre more. It is worthy of note that precisely the same operation upon the self-same soil may be made to cost 2s. or 3s. more in one case than another, from no other cause than having a short field instead of a long one, or from being dilatory, instead of smart, in working the implement at both ends of its journey.

Mr. Bulstrode found that he could not get the full benefit from his patent snatch-blocks on account of another hindrance—the delay in reversing the two drums on the windlass. This he overcame by a remarkably simple expedient. The windlass has two lever handles for turning the eccentric "bushes" of the two rope-drums by which the raising "into gear" and lowering "out of gear" are effected; and Mr. Bulstrode wished to change the position of both drums simultaneously by a single movement instead of by first working one handle and then the other; so he set up a light wooden gallows over the two handles, or, as he expresses it, he "balanced the drums."

After this, it was found that a few seconds might be gained at the implement; for time was wasted in taking the steerage-handle off one end of the cultivator and pinning it securely upon the other end. This point had been already attended to by Messrs. Howard, and was remedied by the use of a double-hinged handle instead of the single moveable handle.

One other *occasional* hindrance remained. When the steam was shut off,

the recoil arising from the tension of the tight rope sometimes caused the pinion-shaft to run the reverse way for a few revolutions; and it was not safe to throw the drum into gear while this was taking place. To meet this, Mr. Bulstrode gave the engine-driver a wooden lever, which he presses as a brake between the fly-wheel and the fire box the instant he has turned off the steam. Thus, by a few simple contrivances, almost all the advantage is got out of the patent slings, and the delay from shifting snatch-blocks is absolutely *nil*, though hindrance at each end of the field, from other causes, still amounts to 10 seconds.

Mr. Bulstrode's pulleys are mounted upon wooden, boat-shaped sledges instead of upon flat boards, in such a manner that, while combining the utmost strength and lightness, they ride over rough ground either to the right or the left, without loading themselves with earth.

One point is worthy of attention in his construction of pulleys or snatch-blocks.

He always employs a bottom iron bar, as well as a top bar because the wooden base-board is liable to decay and to fracture by accidents, and because he can thus *make the pulley "run true," even when the centre-pin, is much worn.* For this object he always keeps a stock of pieces of gas piping, of various lengths, which will slip over the upright pin, selecting the size of the "stop" under the draft-iron, so that the draft-line, shall be exactly in a line with the middle of the rope pulley. Of course, the lower the sheave, or pulley, the shorter is the "stop" put on. If the draft-iron be too low, the upper rim of the pulley will grind against the top bar; and if it be too high, the lower edge will do so against the bottom bar; and, in either case the wear of the centre-pin is increased and unequal, and the risk of overthrows and breakages greater. "This simple matter," says Mr. Bulstrode, "has saved pounds in snatch-blocks and in breakages,"

He does not use the Bedford "compensating" double snatch-blocks, but considers that the one thing still wanted is a compensating-brake, by which the power now lost in giving sufficient tension to the slack or tail rope could be added to the draft of the tight or pulling rope. He has designed one on an entirely different principle to the compensating-brake once brought out by Mr. Fowler, but has not yet got it sufficiently simple.

BERKSHIRE.

MR. JOHN WALTER, BEARWOOD PARK, WOKINGHAM.

LIGHT LANDS.—Mr. Walter holds two farms in his own occupation—"Bearwood," near the beautiful demesne in which his new mansion is being built, and "Tangle Farm," a few miles distant, on the other side of Wokingham; both in an undulating country, thickly wooded with larch, growing furze and ferns too plentifully, and revealing in brooks and pits a superabundance of water. Steam cultivation is practised upon "Bearwood Farm," of 400 acres arable and 300 pasture, presenting a tolerably level surface, in fields of 20 up to 100 acres in area, but with fences not of the very best-grown quick. The land is chiefly a reclaimed heath (indeed, this is the character of the country for miles about); the soil variable—in some places light, with a gravel subsoil, in other parts loamy, with a clay

subsoil, or a black "spewey" gravel, in which water rises up, prevented from sinking by a clay stratum underneath. Part requires underdrainage, and part drains naturally. A pair of horses can plough a furrow 8 inches deep, but, of course, dip the share less deeply for wheat. A team of 14 horses is kept; but as two of these are considered due to the estate-work, the normal force for the farm is really 12; whereas, without the steam cultivator, 18 horses would be required, so that the engine has displaced 6. This, we should say, is the estimate of Mr. Henry Simmons, the manager; for in reality only the same number of horses was previously worked, but on a smaller farm, the acreage having been annually increased (so to speak, "from the wild"), and of course, at first starting, in a very rough condition.

The course of husbandry embraces about one-fifth roots, and the chief benefits of the steam-work are found in the more effectual manner in which the tillages are done, in more successful crops of stubble-turnips, tares, and so on, and, most of all, in "much heavier" root-crops, which must have increased all the other crops too.

The steam-operations consist in grubbing up stubble for roots, and cross-cultivating, for the horse-harrow to follow, with the hand-rake or basket after that in cleansing land of couch. In spring, the cultivator is employed in crossing the fallows, which are horse-ploughed for roots; no seed-bed as a rule) being wholly prepared by steam. We did, however, see (the first week in November) a piece of good vetches coming up, which had been drilled after steam tillage. The swedes on Bearwood Farm are uncommonly good ("splendid," our note-book jotted them down); they were got in directly after horse-ploughing land that had been autumn-tilled by steam.

The tackle, consisting of a Clayton & Shuttleworth's 10-horse power double-cylinder portable, with a Howard's windlass, 3-furrow plough, 5-tined cultivator, side-harrow, and a set of harrows, was purchased in September, 1862, for £616; and the cost of additions, including a new rope in 1865, has been about £100. The general repairs and overhauling the engine and tackle, in the autumn of 1865, cost about £35. The engine thrashes the farm corn, and on only one occasion has the cultivating-tackle been let out for hire, when 30 acres in one field were cultivated twice over, at 10s. per acre, and "with a profit."

The first rope lasted three seasons; the present rope is scarcely worn at all. One windlass-pinion has been renewed, the other is nearly done for, and the india-rubber "universal joints" (now, we believe, abandoned by the makers for a more durable plan) want renewing. We observed that the compensating double-snatch-block was altogether out of order—in fact, wrongly put together by the men. The implement at work was the 3 and 5-tined cultivator; the rate of its performance is 8 to 10 acres a day. The plough is not much used: it required a man walking "at the head" to assist in steering, and never exceeded 5 acres per day. This points to some peculiarity in the state of the land at the time, or to the management of the tool; for, according to what we have witnessed elsewhere, swerving from its work is not a fault inherent in the implement itself. In this soil a single anchor to a snatch-block is found insufficient, and to prevent slipping or tearing through the loam and gravel, two anchors are set, one behind the other. Owing to this disadvantage, the Bulstrode-slings cannot be (or, at

least, are not) worked; though in other places we have seen the slings used easily enough with duplicate anchors. The hands are ordinary farm-labourers: engineman at 3*s.*, windlass-man, 2*s.* 6*d.*, ploughman, 2*s.* 4*d.*, two anchormen, 2*s.* 4*d.* each, and two porter-boys and a watercart-boy, at 1*s.* 4*d.* each per day. Water is always found close at hand in ponds on the farm. Oil costs 1*s.* 2*d.* per day, and coal, at 21*s.* a ton, costs about 8*s.* a day. "Shifting" takes place about twice a week, occupying 6 horses 4 to 6 hours each time.

We have said that 6 horses displaced, or £264 a year saved in draft-labour, go to the credit of the engine. The manual-labour account of the farm has been increased rather than diminished; but the main results of steam culture (though not specially pointed in this case) are satisfactory from the decided augmentation of produce.

BERKSHIRE.

MR. JAMES WILLIAMS, SHIPPON, ABINGDON.

LIGHT LANDS.—Mr. James Williams, of Shippon, near Abingdon, a land-valuer and agent as well as farmer, occupies over 600 acres, chiefly arable; most of the land stone-brash, commonly thought unadapted for steam culture, seeing that its tillage is ordinary pair-horse ploughing at 5 inches deep. The system of husbandry is the four-course, occasionally with barley after the last wheat-crop. In 1858, Mr. Williams purchased a 10-horse double-cylinder portable, with Howard's tackle, and has since added a Fowler 3-furrow plough. And this has enabled him to sell off 6 horses; the apparatus being also sent out on contract-work, besides every year tilling about one-third the area of his own farm. What is Mr. Williams' present force of teams we did not hear; but some extra horses are required for occasionally taking about the country several steam thrashing-machines, which he lets out.

The prices charged for steam-tillage work are 14*s.* an acre for grubbing once over, and 20*s.* for grubbing twice over, the farmer finding coal and water—the latter a light item, from the circumstance of water being obtainable anywhere in the locality at a few feet depth from the surface. Of course it would be hardly fair to detail all the several expenses involved in this work, because some neighbours might and would then say, Why do you charge us so much per acre, when actual cost to you is very considerably less? not making allowance for the distinction between a man's working for them and working for himself, for the differing risks of wear and tear under the two circumstances, and for the necessary laying by of a good annual sum with which to buy a new fire-box every now and then, pay for new parts necessitated by some unlooked-for accident, and ultimately replace a worn-out "set" by a new one.

But Mr. Williams speaks of comparatively few breakages, while the regular repairs have not been very heavy. The wear of rope—the principal item in the damage to the machinery—he has found to be as nearly as possible 1*s.* per acre. The common rate of performance is 5 to 7 acres per day with the 3-tined cultivator, or 7 to 10 acres with the 5-tiner. In a very long day a much larger quantity has been got over. With the 3-furrow

plough, 4 or 5 acres are turned over in a day; this having been shallow work for wheat-sowing.

Autumn breaking-up of stubbles answers admirably; but Mr. Williams attaches quite as much importance to ploughing in this season; in fact, he averred to us that one of the most valuable uses of the steam-tackle is in ploughing over wheat-stubbles, to lie through the winter and then to be cross-cultivated by steam in the spring for barley. He has obtained an increased yield of corn on a steam-cultivated seed-bed; he also now gets double the former weight of roots per acre, and necessarily, after more roots, he has more corn, and so on through the rotation. But then this result is not all referable to the employment of a steam-horse; unquestionably the 300 fine Berkshire hogs that we saw fattening upon buckwheat (of which cheap imported feeding-grain and other corn 1000 quarters are annually consumed in these farm-premises), have something to do with the matter. Mr. Williams declared that he would never be without a steam cultivator on that or a like farm; and moreover told us that on a deep-loam farm, a former pupil of his had found "every inch deeper" equivalent to an artificial manuring—an acquisition likely to be experienced only for a time, though this may last through a considerable course of years.

CAMBRIDGESHIRE.

MR. ALFRED S. RUSTON, CHATTERIS, ISLE OF ELY.

MEDIUM OR MIXED-LAND FARM.—This holding consists of six farms of all sorts of soil, from a strong clay to a blowing dust, and what is termed a hot dust. In extent it comprises 940 acres, 800 being arable. For the most part the farm lies in "high land" and "low land." The low is fen-land. The steam-power is generally used on the high—that is to say, on about 160 acres, where the following system of cropping is observed: 1, barley; 2, beans; 3, wheat. The wheat-stubble here is broken up by steam in the autumn, worked again in the spring, after which barley is sown. The bean-land is broken up by steam and cleaned for wheat. The established rule is to steam three times in three years, and to plough with horses once. On some of the fen-lands steam is used every five years. The usual course of husbandry is as follows:—1, fallow; 2, oats; 3, wheat; 4, seeds; 5, wheat.

The object for which Mr. Ruston bought the tackle is fully accomplished. This object is, on his own high lands, to get a crop every year, a fallow being formerly given every fifth year; and he expects by his present mode of management to keep his land as clean as when fallowed once in five years. The results of the two first years defrayed the whole cost of the apparatus; and now the land is as clean as it would have been under the old horse-system. A great deal of use of the apparatus has been made on the fen-land, when nothing could be done on the high lands. Deep cultivation is here an invaluable process by mixing the clay and gravelly subsoil with the staple. Mr. Ruston has derived much advantage from turning up the soil with a steam plough purposely made for the work to a depth of 15 or 16 inches. This is only safe when the couch-grass is abolished. We found the finishing-stroke being given to the harvest. The crops generally fine

Mr. Ruston spoke of largely-increased yields since steam had been employed—fully one quarter an acre of barley and wheat. He has felt the advantage of despatch—steam has thus saved his barley-crop more than once: its use has frequently given him the benefit of the difference between putting the seed in well and badly. His horse-power was 26; it is now 20—2 horses to 80 acres. Mr. Ruston testifies also to the increased efficiency of the drainage effected by the introduction of steam. This we found to be no fancy; for, notwithstanding the heavy and continuous rainfall, the fields felt firm and dry under foot. On some of his own land he takes corn-crops year by year successively, where formerly a system of bare fallow prevailed. No special preparation has been made for steam-cultivation, save the enlargement of the fields, which were and still are small. The supply of water is convenient and plentiful: in quality it is hard, which is not usual with pond-water. One boy, sometimes with, sometimes without, a horse, suffices to convey it to the engine. The land in the neighbourhood is, for the most part, in the hands of men who have taken no steps to encourage the use of steam-power.

The *Apparatus* was bought in November, 1862, of Messrs. Howard. It consists of an

Engine, 10-horse power, single cylinder, made by Ruston, of	£	s.	d.
Lincoln, which had been in use 3 or 4 years for general	150	0	0
farm-work. It is not let out, but thrashes from 500 to 600			
acres of corn a-year, besides grinding, and tillage work, value			
1 set of implements, windlass and rope (1600 yards)	230	0	0
Deep plough	60	0	0
Side-harrow	3	10	0
Carriage and man to start the tackle	20	0	0
	463	10	0

Repairs, Renewals, Wear and Tear.—The breakages have mostly arisen from the carelessness of boys. These, with wear and tear, have been very slight—principally in porters, wheels, and snatch-blocks, of which no exact account could be rendered. One rope has done all, and is now getting weak.

Work done.—In spring, 7 acres a day of 10 hours; in autumn, 8, 9, and 10 acres. Deep-ploughing, 2½ to 3 acres.

	Acres deeply ploughed.				Cultivated.			
1862	84	...	...	...	...
1863	71	...	...	...	247
1864	14	...	...	...	219
1865	20	...	...	...	838
1866 to Sept. 12	115
				189				919

N.B.—Removals are paid for by the hour. They occupy from a half to a whole day; 10 horses concerned in the removal.

Cost of work.—*Manual labour*, 5 men and 4 boys: when working by the day the ordinary payment is received, with 1s. 9d. extra for engine-man, windlass-man, and ploughman: when by the piece, they have 2s. 6d. per acre—working till 7 or 8 o'clock in the autumn.

	£	s.	d.
7 acres at 2s. 6d.	0	17	6
Coal—"Portland" and "Brindley Hards," 15s. per ton, home; }	0	7	6
‡ ton per day			
Oil	0	1	0
Total per day	1	6	0

CUMBERLAND.

MR. W. NORMAN, HIGH CLOW, ASPATRIA.

HEAVY LANDS.—At Blennerhasset we met Mr. W. Norman, who has had Howards' roundabout system for one year. His farm contains 630 acres of arable, mixed soil. He has cultivated for roots, and also, after roots, for corn; 220 acres were worked, averaging $5\frac{1}{2}$ acres a day, including removals. The tackle consists of 10-horse-power (Clayton & Shuttleworth) engine, windlass, cultivator, and side-harrow—costing £550; four horses have been put down. The engine is used largely for thrashing. The cost of working each day is: for labour, 13s.; coals, 5s.; and oil, 1s. 6d.—total 19s. 6d. The charge for wear and tear and interest cannot be so heavy as in any preceding case, so that Mr. Norman may probably make steam cultivation pay. We were assured that the land in winter lies drier than before.

CUMBERLAND.

MESSRS. CARRS, CARLISLE.

HEAVY LANDS.—From Blennerhasset to Silloth by road, to inspect the results of Howard's roundabout tackle on the farm of Messrs. Carrs, of Carlisle, who here occupy 414 acres, of which 390 are arable, besides 24 acres of sea-bank. The soil varies from a strong clay to rich loam on red sand. The tackle consists of 10-horse-power engine, windlass, and cultivator: 12 horses have been reduced to 8. Steam cultivation is entirely confined to the fallow-land; usual depth of cultivation, 8 to 12 inches. No work has been done this autumn, as it was impossible to cultivate on account of excessive moisture; and the question here, as elsewhere, arises—Should not a plough be regarded as one of the necessary items? It is quite certain that, in all cases where a plough was employed, a good deal, if not all the autumn-work has been got over; whereas, in most cases where the cultivator only is kept, work was out of the question. The average quantity cultivated per day amounts to about 5 acres.

The apparatus, consisting of a 10-horse-power engine by Clayton & Shuttleworth, with Howard's cultivator, was purchased second-hand in the spring of 1864, at some reduction on cost price. No work had been done by it, however, and therefore for the purposes of this inquiry it will be as well to charge £550 as the total outlay. The subsequent repairs have been very moderate, and are assessed at £6 per annum. The fields are large, the surface perfectly flat, and if the drainage were better the land would answer admirably, as larger areas can be worked without a shift; 70 acres of fallow are worked generally 3 times over, or 210 acres in all in 42 days, the engine being employed an equal time thrashing, grinding, &c. The expenses per day can be easily calculated:—

	£	s.	d.
Labour: 2 men, 3 lads, and 2 boys ... ..	...	0	12 0
Water-cart and horse ... ..	...	0	4 0
Coals and oil ... ..	...	0	10 0
Repairs, estimated at £10 ... ..	...	0	4 9
Wear and tear on £160* at $7\frac{1}{2}$ per cent. ... ..	...	0	14 3 $\frac{1}{2}$
Interest at 5 per cent. ... ..	...	0	9 6 $\frac{1}{2}$
Daily cost ... ..	...	2	14 6 $\frac{1}{2}$

* Deducting half cost of engine.

—10*s.* 10½*d.* an acre for each operation, and an annual expense of £114 10*s.* 9*d.*, against which we have the saving of 4 horses at £45 each—leaving a balance in favour of steam of £55 8*s.* 4*d.* The shepherd, who showed us the farm in the absence of the tenant, considers that in dry weather it would be practicable to scarify for corn after roots fed off; but, as a rule, horse-ploughing is preferable. Clover appears to come thicker and the grasses grow more vigorously after steam culture, whilst the surface dries more rapidly than formerly, in consequence of increased depth. The land is fertile, very heavily stocked, great crops result, and the whole appearance was like paying rent.

DORSETSHIRE.

MR. GEORGES BARNES, AGENT FOR MRS. S. C. HAWKINS, OF ALTON PANCRAS, DORCHESTER.

HEAVY LANDS.—Mr. George Barnes has a Howard tackle, working a cultivator, side drag-harrow, and large drag, with a 10-horse engine. In 1862, the whole cost over £600,—a new cultivator since added bringing the investment up to £625. The repairs have been accomplished by the farm smith. The farm embraces 700 acres of arable, and more than 700 acres of pasture; the soil clay, chalk, with different subsoils, and very hilly and flinty. The fields vary from 9 to 84 acres: little alteration having been made in preparation for steam work. From 5 to 9 acres are cultivated in a day, with a consumption of about 1½ cwt. of coal per acre. Water is brought from made ponds by horse and water-barrel. To move the machinery takes 10 horses, and half a day's time. The engine is used for thrashing.

Mr. Barnes finds the drainage quickened; he has increased the area of his root crops; and says, "in 1864, the season was very dry, and roots generally very bad: theirs was a fair crop, caused, he thinks, by the land being prepared early in the season by steam cultivator." They formerly worked 32 horses, but since the cultivation began only 22 horses are kept.

DORSETSHIRE.

MR. MILES RODGETT, SANDFORD, WAREHAM.

LIGHT LANDS.—Mr. Miles Rodgett, of Sandford, Wareham, Dorsetshire, has reclaimed and broken-up to tillage, out of gorse and heather, between 400 and 500 acres of poor sandy and gravelly Heath, by a Howard 5-tined cultivator, and a set of "steam-harrows;" the engine being a double-cylinder 10-horse power. With half a ton of coal, at 20*s.* per ton, he cultivates 6 to 8 acres per day. His engine-driver has 15*s.*, ploughman 14*s.*, windlass-man 12*s.*, his anchor-men 12*s.* each, four porter-boys 6*s.* each per week. The engine is always set down where water is, and a boy to pump it costs 6*d.* a day. Removal occupies 4 horses for a day.

The whole tackle cost £500, in February, 1864; and a ridging-plough and 400 yards of extra rope were added for £35. Repairs in two years and a half amounted to £10 for "points" worn out and porters broken. Mr. Rodgett works with 2000 yards of rope in use at once, and in 1865 reported that it had gone over about 4000 acres, and that it was "showing signs of weakness." The cost price of the rope, we suppose, would be about £90, or 5½*d.* per acre, a low rate attained by lightness of work and four porter-boys.

ESSEX.

MESSRS. IMPEY & BOTT, BROOMFIELD, NEAR CHELMSFORD.

MEDIUM OR MIXED-LAND FARMS.—September 6th we visited the farms of Messrs. Impey & Bott, of Broomfield, near Chelmsford, tenant farmers, who had worked steam in partnership. Mr. Impey occupies a farm of 500 acres, on which 2 horses are sufficient to turn a furrow 6 inches deep. He is engaged with Mr. Marriage, of Croydon, in the wholesale milk trade in London, and keeps from 50 to 100 milch-cows: has but 50 acres of grass land, and is therefore obliged to depend very much upon green crops. Most of the soil rests upon clay: there is a portion upon gravel. All the clay has been drained either by hand or by Eddington's steam mole-plough, the latter work being 10 feet apart, 30 inches deep, and answering admirably. It is done by Messrs. Impey & Bott's own tackle, which is also let out in the district. The gravel land has been drained by hand when needful. The benefits of this work have been much increased by deep steam-tillage. The horses are reduced about one third in number; but more is done. The carting of milk and grains occupies several. Mr. Impey, who has employed steam because he wanted more return from his land, says that he has not been disappointed. Not only does the additional power afford facility for getting more crops off the land—for this in a great measure is due to its speed—but by the deeper movement of the soil resources are brought into play which insure heavier crops. The breadth of the root-crop has undergone no change, but greater weight is attained. A green crop is almost uniformly secured before turnips. Mr. Impey is of opinion that steam is of as much value to him on his light as on his heavy land.

The farm lies very well for steam. The fields have been enlarged, but no roads have been made. Water of good quality is supplied from ponds within easy reach, and the engine is generally fixed by the side, and feeds itself. Thrift, neatness, superior management, excellent root-crops, strong stables were apparent everywhere. No fancies are indulged; farming is undertaken for profit.

The *Apparatus* first obtained was Eddington's. It consisted of 2 engines mounted on windlass frames, a 4-furrow plough and connecting ropes. In this venture, which was found to be "too cumbersome," Mr. Bott took part. It was abandoned for 2 sets of Howards' tackle, the engines being retained, together with Fowler's 4-furrow, which are still worked between them. These 2 sets of tackle were bought July, 1861.

1 set of tackle cost	... ..	£290
1 engine 10-horse power, double cylinder, manufactured by Clayton & Shuttleworth	270	
Half the plough	80	
	<u>£550</u>	

Repairs, Renewals, Wear and Tear.—No precise data as to repairs of engine, which is used for thrashing, and looks in very good cue. Mr. Impey's experience leads him to charge the work done with 1s. 6d. per acre on account of the rope, 2s. per acre on account of the implements, engine, etc., and 7d. per acre on account of wearing parts. The boiler is cleared of deposit once a month, and the tubes are drawn every second year.

Work done with the *Cultivator* in a day of 10 hours, exclusive of removals, which occupy 4 hours and require 8 horses, nearly 6 acres. With the 4-fur-

row plough from 8 to 10 inches, 6 acres. Since the commencement about 2000 acres have been worked. Very little work is done for hire. There is little or no time for it. The engine power is found to be quite sufficient. Much use is made of Fowler's plough. It is frequently used without breasts, and thus fitted, a "single operation with it is equal to two with the simple cultivator." The possession of the plough, too, is found to be of great advantage when cultivation cannot be done. Two anchors coupled are found competent to bear the strain.

Cost of Working.

<i>Manual and Horsework:—</i>						<i>£</i>	<i>s.</i>	<i>d.</i>
Engine-man	...	...	...	...	...	0	3	6
Ploughman	...	...	...	...	...	0	2	6
Windlass-man	...	...	...	...	...	0	2	6
2 boys	...	...	...	...	...	0	2	6
Horse for water-cart occasionally	...	...	...	...	...	0	1	0
2 Anchor-men	...	...	...	...	...	0	4	0
						<hr/>		
						0 16 0		
Coals	...	...	...	...	...	0	13	0
Oil	...	...	...	...	...	0	1	0
						<hr/>		
Total cost per day						1	10	0

N.B.—*1d.* extra per acre to each man, and $\frac{1}{2}d.$ to each boy while working, by way of stimulus.
Coal—"Seaborne," price *21s. 8d.* per ton home, consumes 12 cwt. per day of 10 hours.

Mr. Bott occupies adjoining farms, which consist of 490 acres (30 pasture) of better land than Mr. Impey's, but he is less advantageously situated for steam, the fields being many of them small irregular enclosures, which straggle away into other properties in such a way that nothing save a give-and-take arrangement amongst the neighbouring landowners could set right. Nothing but the roundabout system would, in his opinion, do here. The removals are very frequent, and in comparing the cultivation of his small fields with Mr. Impey's, he finds that in the long run he does about 1 acre a day less. Whereas the cost of coal to Mr. Impey is 2 cwt. per acre, to Mr. Bott it is $2\frac{1}{2}$ cwt. He nevertheless persevered, from his high estimate of the value of steam power. Since 1861 he, like his partner, has done 2000 acres. The apparatus is in all respects like the former—the two engines, which are employed two-thirds of their time off the land, are managed by well-trained men. The staple is rather a deep loam, upon a brick earth. The farm is most of it drained by steam. The horses have been reduced from 18 to 14.

The special utility of steam power has been witnessed in the case of a neighbouring farm of 140 acres in very foul condition, which was entered Michaelmas, 1865, by Mr. Bott, and put right, or nearly so, in a single year, without calling in any additional power. We saw the greater part of it and a splendid root-crop looking very clean. First it was drained by steam, then 3 times cultivated with Howards' implement, twice with Fowler's plough, once with breasts off, once with them on. The conversion could not otherwise have been accomplished in the time or at the cost, which was exceedingly moderate. Mr. Bott is a thoroughly practical man; he not only farms for profit, but profitably; his farm is well managed, and his stock well bred. These two cases may certainly be considered to present the claims of steam in a very favourable light in the neighbourhood where they exist.

FLINTSHIRE.

MR. VINCENT GOSFORD, OF TANYLAN, HOLYWELL.

HEAVY LANDS.—In May, 1861, Mr. Gosford began steam cultivation with a set of Howards' tackle, including a cultivator, a 3-furrow plough, with two extra bodies for deep work, a single plough for very deep work, and heavy steam-harrows, driven by a 10-horse engine. The cost price was £672. Wearing parts and fittings have cost £25 10s. 6d.; alteration of cultivator, 12s.; and small repairs, done at home, not exceeding £5. In 1865 a new rope was supplied.

The farm comprises 414 acres arable and 100 grass,—three-fourths of it a deep alluvial soil,—the rest lighter. It lies perfectly level, in square enclosures averaging 20 to 30 acres each, intersected by four straight water-cuts for the drainage, these being very convenient for feeding the engine.

The engine—consuming on an average half-a ton per day, at 12s. 3d. per ton on the ground, with a boy supplying water by a pail—ploughs 5 acres a day, or, with the deep plough, 15 inches deep, 3 acres; or cultivates with the 3-tiner, 6 acres, and with the 5-tiner, 8 acres per day. With the harrows, it does, once over, about 16 acres per day. The engine-man (the farm blacksmith) has 2s. 6d.; windlass-man, ploughman, and two anchor-men, 2s. 2d. each; two porter-boys, 1s. each; and the water-boy, 8d.; total wages, 13s. 10d. per day. Four horses move the tackle in two hours, on an average, “ready to start.” The engine does the farm thrashing. Mr. Gosford has diminished his number of horses from 20 or more to 12 now.

He says that the drainage is “unquestionably” improved. “After the deep ploughing the rain-water quickly disappears, and the land is ready much sooner for the implements. After the old shallow ploughings the small hollows silt up and hold water like basins for weeks. On this flat soil the land, after *cultivating*, was washed down so closely that the work had frequently to be repeated, whilst the best possible seed-bed is left after the deep ploughing.” The plough was not purchased for the first two seasons. He has altered his rotation by much enlarging the area of root-crops, “as we can now successfully grow root-crops on the strongest land.” As to increased productiveness, he writes, “I have no hesitation in saying that the farm is in course of progressive improvement, entirely attributable to steam cultivation.”

GLOUCESTERSHIRE.

LORD SUDELEY, TODDINGTON, WINCHCOMBE, CHELTENHAM.

HEAVY LAND.—Lord Sudeley, worked a Howard set of tackle with a 10-horse engine, in 1864-5, but that one year's experience proving that more power was needed on strong land and in very deep work, a 12-horse engine was procured; the tackle now consisting of one of Messrs. Howards' traction-engines, with boiler placed transversely across the framing, which carries two winding-drums, of snatch-blocks, anchors, porters, &c., for the “roundabout” system, 1600 yards' length of rope, a 5-tined cultivator, a 3-furrow plough, and a “traction-waggon,” the total cost being £968. In a year and a half the “repairs” have amounted to £34 2s. 10d., chiefly from breakages of wheels or pinions, which were made of cast, instead of malleable

iron. The working expenses are—labour, four men and four boys, 15s. a day; water, sometimes carried by boy, sometimes fetched by horse and cart, average 2s. per day; removal, taking 2 horses to haul out the rope, occupies an hour and a half to take up and set down, exclusive of time spent in travelling; oil costs 1s. 3d. a day; and coal, at 17s. to 19s. a ton delivered, costs about 12s. 6d. a day. The fields (now altered for the purpose) average 20 acres each; the soil is very tenacious, the subsoil a very stiff blue clay, and the surface hilly, presenting some steep inclines; and under these conditions the steam-plough turns over about 3½ acres per day, with furrows 10 to 12 inches deep. Last year the cultivator averaged about 4½ acres per day, including removals and stoppages.

The farm has only 100 acres of arable, besides 160 acres of grass; and the apparatus is let out for hire, having worked upon ten different farms last year—on terms noticed below.

Mr. Thomas Colsey, the agent, reports that the drainage is considered more effectual after the steam tillage, that root crops are fed-off with more advantage, and that a considerably larger breadth of roots is now grown. The team-force kept consists of 4 horses.

Mr. Thomas Colsey, agent to Lord Sudeley, lets out a Howard set of tackle (with one engine). In 1864 the

Total number of days working was	...	...	...	...	...	98½
Days lost by bad weather	...	...	...	...	...	14
Days lost by breakage, about	...	...	...	...	...	24

And 40 days more were lost through lateness of season in commencing.

When not steaming the hands are employed in general estate-work, such as repairing roads.

As an index for hirers and proprietors of apparatus, we give the following "card" of prices charged:—

TODDINGTON STEAM PLOUGHING AND CULTIVATING APPARATUS.

The following Terms are to be taken only as a basis for the Charges of Hiring the Steam Apparatus.

PLOUGHING.						£ s. d.
Stubble, 6 inches deep	...	...	...	per acre	12	0 0
After green crop, ditto	...	...	...	"	0	17 6
Stubble, 8 inches deep	...	...	...	"	1	5 0
After green crop, ditto	...	...	...	"	1	1 0
Stubble, 9 inches deep	...	...	...	"	1	10 0
After green crop, ditto	...	...	...	"	1	5 0

CULTIVATING.

Breaking up Stubble, Seeds, &c.

				s. d.	£ s. d.
Six inches deep, once over	...	...	per acre	12 0	0 19 0
2nd time over	...	...	"	7 0	
Seven inches deep, once over	...	...	"	13 0	1 0 6
2nd time over	...	...	"	7 6	
Eight inches deep, once over	...	...	"	14 6	1 3 0
2nd time over	...	...	"	8 6	
Nine inches deep, once over	...	...	"	16 0	1 6 6
2nd time over	...	...	"	10 6	
Ten inches deep, once over	...	...	"	17 6	1 9 0
2nd time over	...	...	"	11 6	

Breaking up old pasture (in addition to the above charges), once over, 3s.; second time, 1s. 6d.

Crossing Steam-Ploughed Furrows

					<i>s.</i>	<i>d.</i>	<i>£</i>	<i>s.</i>	<i>d.</i>
Eight inches deep, once over	...	...	...	per acre	11	0	1	0	17 6
2nd time over	...	...	...	...	6	6	1		
Nine inches deep, once over	...	...	...	...	12	0	7	0	19 6
2nd time over	...	...	...	...	7	6	1		

Subsoiling below Plough-Furrow

					<i>s.</i>	<i>d.</i>	<i>£</i>	<i>s.</i>	<i>d.</i>
Four inches below furrow, once over	...	...	...	per acre	15	0	1	3	6
2nd time over	...	...	...	...	8	6	1		

The above prices will be charged for the working of ordinary clay lands; they will vary with the condition and description of the soil, the amount of work required to be done, the size and shape of the fields, the convenience of coal and water supply, and other minor considerations.

No field will be charged for as being less than 8 acres.

All expenses are included in the price named.

In consequence of the new engine being a *traction* engine, the prices have been raised, but they include, in *addition* to the former charges, the expenses of removing the apparatus, for which purpose horses will *no longer* be required to be sent.

April, 1865.

Messrs. Howard's traction engine has the boiler placed transversely across a carriage-frame, so as to avoid fluctuations of the water-level in ascending or descending inclines; and the steerage is accomplished by a single wheel turning on a "transom" in front. It is fitted with two rope-drums, so that there is no separate windlass to be moved, set down and so on; and the consequent celerity with which the apparatus takes up its position for work, effects a wonderful saving in time.

HADDINGTONSHIRE.

MR. GEORGE HOPE, FENTON BARNS, DREM.

HEAVY LANDS.—Mr. George Hope occupies 670 acres arable, with 2 only of old pasture; a medium loam-soil, in places more clayey. High-backed lands were at one time adhered to; but in the early days of under-draining the farm was tile-drained at 2½ feet depth, and flattened, and now it is always sufficiently dry. A Howard apparatus, with 10-horse engine, was purchased in September, 1863, has done more than 1200 acres of tillage since that time, and excepting the rope, appears as sound and good as ever, and has incurred no expense in repairs. All the work has been grubbing,* and in consequence of this aid all operations are so forward in autumn and in spring that Mr Hope "wonders how he ever got on before." He has parted with three horses, and would be able to sell off more, if he had not so much carting of potatoes, besides a new farm, distant 2½ miles, at which many improvements are being made. He finds that he can do a 30-acre field at one setting down, and by simply turning the engine and windlass round does 60 acres from one position. All his steam-work is done with inferior coal, costing 10s. a ton with the cartage.

* Since the visit of the Committee, Mr. Hope has purchased a Fowler's 4-furrow balance plough, which he works with his Howards' apparatus, and finds lighter in draught than the cultivator. He can now easily and certainly regulate the depth of the work; this he formerly failed to attain where strong clay and sandy soil alternated in the same field.

Mr. Hope considers that he is well repaid for his investment by the deeper and better tillage, and by the winter-exposed land being sooner ready for sowing in spring. Then the yield of cropping is greater, from the fact of the crops being more equal. This is due to the more timely sowing; instead of having some fields too early and others too late. Mr. Hope's root-crops are "a treat to see," and every square foot of ground wonderfully clean, the turnips growing up to the very stems of the quick hedges; and there, instead of weeds and grass, rape shoots out from the hedge-bottoms. The hedges are cut once a year, and the bottoms dug every time a crop is put in.

It is not part of our embassy, however, to make notes of Scottish husbandry; we had simply to form an impression as to the value or uselessness of the steam-plough on farms where everything had been about perfection already; and the impression we brought away with us is, that the heavy investment of a steam-tackle is found to pay well even upon the neatest and best-managed occupations where first-class farming has been practised for generations.

HAMPSHIRE.

MR. JOSEPH LANCASHIRE, MICHELDEVER.

LIGHT LANDS.—Catching an early train from Southampton on the morning of the 27th of September, we arrived to breakfast, and subsequently made a tour of the farm, and saw Howards' apparatus doing some very good work. The farm contains 725 acres, lying on the chalk over an undulating surface. On the uplands the depth of soil is about 3 inches, in the lowlands 3 feet. When Mr. Lancashire entered, five years since, it was exhausted of fertility and possessed by weeds. The change wrought is due to the spirited investment of capital, in which steam has its share. Labour, for instance, costs £1 per acre, while the annual outlay in artificial manure, cake, and corn, may be put down at a little over three rents. For bones and phosphates alone, the expenditure is £500. The owner, Lord Northbrook, allowed his tenant to enlarge fields, which now average 30 acres; the hedge-rows are low and denuded of timber. Something has been done to construct roads. The supply of water is scanty; and coming from the chalk, is so bad in quality, that a wine-glassful of Le Franc's fluid is used each morning, which costs 1½d., and serves the day. The effect is surprising; were it not for this remedy, the wear in the boiler would entail heavy expense. The course of cropping is as follows: (1) roots, (2) wheat or barley, (3) seeds, (4) wheat. On wheat-stubble tares or trifolium are taken before roots, two crops in one year—a great point, much facilitated by the use of steam. On the inferior land he secures two root-crops, and takes wheat or oats seeded down. The seeds lie two years, and are then broken up for wheat or oats. Mr. Lancashire's great object is to get sheep-feed. A flock of 600 breeding ewes (with the female produce) gives an average of 800 mouths to be filled from the 725 acres, besides other stock. He farms also very much for the great hay-market, which he supplies with large quantities of sainfoin hay.

For labour he is inconveniently situated. Micheldever is two miles distant.

He has but eight cottages; three of which, brick upon wood foundations, have been erected at his own expense. The wages for ordinary labourers, 10s. a week, are high, considering their indifferent character. The hours of labour, from 6 a.m. till 5.30. The employment of steam gives him advantages, for the best class of men crave the better wages connected with its use, and are stimulated to better pace. Mr. Lancashire very sensibly trains the men to the use of the engine; he explains to them sectional drawings of the machinery, thoroughly indoctrinates them into its principles, ensuring at the same time that they possess a competent knowledge of the combustion of fuel, and the production and expansion of steam.

Mr. Lancashire's experience indicates that the employment of steam tends to lengthen the labour-list. This ought not to surprise us if we bear in mind that the engine only "cuts out the work" of more thorough and frequent tillage, leaving the finishing touches to be done by the hands. Since these run short, he is obliged, like the American farmer, to resort to various implements. He owns 2 large corn-mowing and 3 grass-mowing machines. With the former supported by 8 scythes, day by day he swept down 46 acres of corn, and was placed very advantageously in advance of several neighbours, who were caught by the heavy rains. To keep these machines thoroughly employed in their several seasons, 12 horses are needed. The entire stud consists of 14, that is 2 to each 100 acres. To have produced part only of the change he has done, "would," to use his own words, "have required 20 horses."

The *Apparatus* was bought of Messrs. J. & F. Howard, in 1861.

The *Engine*, an 8-horse power double cylinder, was made by Messrs. Tuxford, and having been worked for six years, was purchased for £130. The new engine works up to 100 lbs. steam-pressure with as much safety as some engines with 45 lbs. This is due to extra stays, the advantages of which are not sufficiently known. A thick boiler-plate, unstayed, is of little advantage. If guaranteed to work to 100 lbs., an engine stands much longer than one of inferior strength.

The *Cultivator*, windlass, 1400 yards of rope, porters, from Bedford, cost £240.

Repairs, Renewals, Wear and Tear.—The *engine*: during the first four year's repairs did not reach £5; those incurred were due to frost. The slightness of the expense is attributed to the use of the fluid already mentioned. The repairs in 1865 were £5. A stronger engine being required, the one of 8-horse power was valued at £130, returned to the makers, who, on receipt of £170 in addition, sent a 10-horse power engine, extra stayed. "The engine does not cost 9s. a day to keep in repair and renew in 8 years. If I lay by 7s. a day, Mr. Tuxford would be willing to renew it for the sum of the deposits so made, whenever it shall be worn out." The former engine has been used for thrashing, grinding, chaff-cutting, about 2 days each week for 30 weeks.

The rope was supplied in additional quantities last autumn, and the present—1865, 1866—the price of which, diffused over the acres cultivated, shows the wear then to be just 1s. 3d. per acre.

Work done, and Mode of doing it.—The day's work of 10 hours, including removals:—First time, breaking up 6 inches deep, average 5 acres; second

time, 6 or 7 acres. It is customary to break up the stubbles in harvest, manure, and sow tares to be early fed, and then broken up for turnips:—

<i>Manual Labour:—</i>		<i>Cost of Work.</i>		
		£	s.	d.
Engineer	...	0	2	6
Windlass-man	...	0	2	0
2 anchor-men	...	0	3	8
Ploughman	...	0	1	8
2 porter lads	...	0	1	8
Boy, water-cart, horse	...	0	5	6
		<hr/>		
		0 17 0		
Coal and oil	...	0	7	3
		<hr/>		
Total daily expense		1	4	3

N.B.—The men receive 2*d.* per day extra, and occasionally a quart of ale. "Ale goes further than money." Coal—"Shipley Hards," from Derbyshire; 18*s.* per ton home; consumption, 7 cwt.

The choice between a long rope and infrequent shiftings and a shorter rope and more frequent shiftings, depends, in Mr. Lancashire's opinion, on the nature of the soil. If a sharp soil, very little rope should be out; some advocate 2000 yards of rope—he does not.

The old rope is used between the anchors on the headlands, with a sling. He has often seen old ropes coiled up doing nothing; sometimes served out to act as the top-wire of fencing. He considers 500 acres of arable land the smallest quantity on which steam cultivation should be practised; would advise no one to go into it without intending to pay thorough personal attention to the machinery. If left to men, it will be sure to be a failure.

The engine-man is a raw recruit. There is a smith's shop on the premises, but no engine-shed; the rope is dressed with tar and grease before being put away.

HEREFORDSHIRE.

THE HEREFORDSHIRE STEAM CULTIVATING, THRASHING, AND GENERAL IMPLEMENT COMPANY (LIMITED).

HEAVY LANDS.—The Herefordshire Steam Cultivating, Thrashing, and General Implement Company (Limited), capital £5000, in 1000 shares, began operations with the first pair of Howards' engines in 1865, and a second pair in October, 1865: at the end of that year the Directors declared a 5 per cent. dividend, and laid by a surplus of £91 toward a Reserve Fund. The Report for 1866 is not yet published, but the manager informs us that they have made a larger profit than they realized the first year. They work the plough but little, the principal operations having been done by the cultivator, whether on loam and gravel soils, on sandstone shale, or stiff clay and marl, on lands where they have torn up immense quantities of rock fragments, or on deeper soils where the tillage has been 15 inches deep. The basis of the scale of prices is 1*s.* per inch depth. The engines have given every satisfaction, in a desperately hilly country, and cost very little in repairs. Mr. J. Philips Smith has applied his engineering ability to carrying out some novel operations. Thus, a mole-plough is hauled by each

engine, draining meadow-land 2 feet deep, at 4-yard intervals, the mole-iron being of $4\frac{1}{2}$ inches diameter. The cost to the farmer is £1 per acre: by previously ploughing a deep furrow, a correspondingly deep drainage is executed; and the work is declared to answer exceedingly well. The advantage of this draining to the Company is that it provides "wet-weather" work for the apparatus and men,—hitherto a weak place in "the hiring system." Mr. Smith has also begun to subsoil hop-yards between the rows of poles,—a single tine on the cultivator going 2 feet deep with a share at bottom of 18 inches breadth.

HERTFORDSHIRE.

MR. G. PALMER, BENGEO, WARE.

MEDIUM OR MIXED-LAND FARM.—We met with a hearty reception from Mr. Palmer, who has thrown into steam cultivation—as he appears to do into all he undertakes—an energy and enthusiasm which helps him to overcome obstacles that would daunt others. He occupies about 1000 acres, lying apart from his house in two farms; one of 450 acres at Watton, 3 miles away, and one at Bengoe of 550 acres. Of the total quantity 800 acres are arable. The heavy land is confined to the Watton farm, where 3 horses turn a furrow 6 inches deep at the rate of 3 roods daily. The soil there is a stiff clay. At Bengoe the soil is lighter—a gravel on wet clay. Mr. Palmer has rented the farms 28 years from Messrs. Parker & Smith. The Watton land is drained 4 feet deep, 2 poles apart (the interval should be less). Water of good quality is plentifully supplied from ponds. The fields vary from 25 to 60 acres. The landlord has permitted his tenant to expend £200 in stocking up hedgerows. The surface of the Bengoe farm is very undulating, and somewhat difficult to cultivate. The 4-course system of cropping is generally adopted in the district. This did not satisfy Mr. Palmer, who substituted for it the following:—barley, clover for sheep-feed, wheat, oats, turnips. This is followed on both farms.

The *Apparatus* was bought in February, 1863. It consists of—

	£
An Engine, 10-horse power, double cylinder, portable, made by Messrs. Garrett	290
A Cultivator, 1600 yards of rope, windlass, &c. (Howard's)	210
	500
Extra porters, home-made, £25, 1 set of harrows, £25	50
	550

Repairs, Renewals, Wear and Tear.—The engine has not cost £5 since it was purchased. The engineer, a thorough mechanic from Garrett's, looks ahead and detects weak places, bad joints, &c., before they lead to general mischief. Without such a man Mr. Palmer feels confident that his repairs would have been very heavy. He has a smith's shop of his own, where repairs are soon effected, and he would recommend no farmer to buy a set of tackle without having such a forge. Since 1865, there have been 2 engines of 10-horse power. He can work with either, but one is usually employed abroad for thrashing on adjoining farms. A new rope of 1600 yards has been purchased since 1863, which is now about half-worn. The

original wheels of the *cultivator* were soon used up: larger ones of wood, made at home, were supplied, which have worn much better. The implement has been strengthened in all its parts. There were no means of getting at the cost of repairs with any exactness. The apparatus being at work we inspected it. The engine we found in excellent condition. It was driven at great speed, and the implement kept the porter-boys on the full trot in the discharge of their duties—the pace was fully 5 miles an hour. The rope was carefully supported. We found a rope-porter with wooden roller in great esteem—also home-made. It is made at a trifling expense. The wooden rollers are replaced as soon as worn, by the wheelwright, and the wear of the rope is perceptibly reduced by their use. The iron rollers last no time under the pressure of the rope over the summits of the sharp inclines which here abound. We observed that the snatch-blocks were blocked up at either end of the implement's course, to keep them more level with the implement. Mr. Palmer and his son had evidently given great attention to the working of the apparatus, and had mastered its details so thoroughly as to enable them to supply several deficiencies.

Work done, and Mode of doing it.—During a day of 10 hours with *cultivator*, the first and second time over, inclusive of removals, 8 acres a day, 6 or 7 inches deep; with *harrows* (harrows 10 feet by 6) once and twice over, 16 acres a day. In preparation for roots the stubble is broken up in autumn with one or two harrowings, which would be better omitted if the land is clean, followed by a cross stirring in the spring.

Cost of Work.

Manual and Horse-labour :—						£	s.	d.
Engineer	...	...	...	...	...	0	3	6
Windlass-man	...	...	...	...	...	0	2	0
2 anchor-men	...	...	...	...	...	0	4	6
Ploughman	...	...	...	...	...	0	2	3
2 porter-boys	...	...	...	...	...	0	3	0
Boy, horse, &c.	...	...	...	...	...	0	6	6
						1	1	9
Coal (15 cwt.)	...	...	...	...	...	0	12	0
Oil and grease	...	...	...	...	...	0	1	6
Total daily expenses						1	15	3

N.B.—Coal, 16s. per ton home; consumption per 10 hours, 15 cwt. = 12s.

Examples of work done abroad :—A 24-acre field cultivated once, harrowed twice = 72 acres, 5 days at £1 16s. per day = £9 7s. 6d. per acre. A 22-acre field cultivated twice, $\frac{1}{2}$ three times 55 acres in 6 days at £1 16s. per day = £10 16s.

The number of horses kept on the Watton Farm

before steam were 16, there are now 12

The number of horses kept on the Bengoe Farm

before steam were 18, there are now 12

84 24

The reduction, therefore, amounts to 10, and leaves 2 horses to 66 acres of land—a very large disposable horse-power—which, with the 10-horse power engine, should be more than sufficient. For want of a plough, surplus horses are clearly kept to do what otherwise might be done by steam. The distance of this farm from the house causes of course more outlay in this direction. Mr. Palmer is, however, perfectly satisfied with

the result, and states that the corn-bill is now £200 a year less than it used to be. He considers that if he had the Bengoe farm with 18 horses and the present engine, it would be good policy for him to lay out £500 in engine and tackle, only to work 4 or 6 weeks after harvest, and lie idle all the rest of the year. £5 per cent. on the £500 (=£25) would suffice to keep it in working order. Speaking of his own district, he considers the want of means on the part of the farmers a sufficient barrier to the application of steam. For the most part they have more land than their capital will cover. The landlords, too, are obstructive; they are far too fond of game to allow the wide, sprawling, irregular hedgerows to be grubbed up. We listened to a strange tale about the combination of labourers to break up the machinery. But the spirit of the thwarted master rose with the difficulties that opposed him. Men were procured from a distance, to whom good wages were paid; the work then went on in first-rate style; for, seeing that he could do without them, his own people begged to be employed, and have since worked well.

HUNTINGDONSHIRE.

MR. ROBERT BARTON, WIGAN FARM, ST. IVES.

HEAVY LAND.—Mr. Barton is a good specimen of a thoroughly practical man, who, though not given to change or to new-fangled notions, embraced steam because he saw in it the means of working a heavy-land farm to advantage. He is a cowkeeper, provides the London market with milk, so that it is a matter of importance to have abundance of green cropping. The land belongs to Mr. F. Annesley. It consists of 700 acres, 500 of which are arable land of so stiff a texture that sometimes 6 horses are required to plough 6 inches deep. The underdrainage was commenced before steam was introduced. Half the farm is drained 4 feet deep. Experience has established the great worth of deep drainage, followed up by deep cultivation. A great deal of the land is now ploughed on the flat. The subsoil is a gaulty clay. The average size of fields is 30 acres. The hedge-rows, which are kept low, are tolerably straight. The fields are undulating and devoid of timber. The 4-course system of cropping is observed: 1st,—Wheat. 2nd,—Turnip-seed, tares, or peas. 3rd,—Barley, oats, and part wheat. 4th,—Two-thirds seed and one-third beans.

Red clover is taken once in 12 years. Dead fallows were dispensed with when steam was called in; all now is in cropping. The land was formerly tilled by 27 horses, or 2 horses to 58 acres; 20 are now kept. The water is good and abundant, save in dry weather, when it has to be fetched 2 miles. It is obtained from storage ponds supplied by drainage.

The *Apparatus* was bought of Messrs. Howard in 1862. The engine, of 10-horse power, was made by Messrs. Hornsby, and valued at £280. They received in exchange for it an 8-horse power engine of their own make, and allowed £65 for the old engine.

The other members were a cultivator, windlass, 1400 yards of rope, etc.:—												£
Price	...	...	...	...	...	...	...	...	...	...	...	200
Extras	...	...	...	...	...	...	...	...	...	...	...	20
												220

Repairs, Renewals, Wear and Tear.—The repairs of the engine are estimated at £30 a year, of which only one-half is charged to cultivation, the engine being otherwise employed. The repairs are greatest on the rope and the snatch-blocks. In 1864, 800 yards of fresh rope were obtained, of excellent quality, and last spring, 800 yards more.

Work done, and Mode of Working.—During day of 10 hours, first time over with 3 tines, removals included, 7 acres; with 5 tines 10 acres, 6 inches being about the greatest depth—"quite deep enough." The steam pressure averages 53lbs.; the removals take 6 horses 4 hours. Notwithstanding the continuous rain since harvest, we found during our walk across the farm that fully 180 acres had been broken up after the crop. A considerable portion of this had grown turnip seed, and the apparatus was engaged upon it all the harvest. We visited no farm on which the tackle had been so efficiently used during the preceding 3 months. The land so treated was lying in a fine, rough state, and, like the reedy stubble, presented a very clean face. The engine was working when we saw it, and the tackle, with the exception of the cultivator, which was weak and strained, was in a fair state. Mr. Barton uses two snatch-blocks and anchors on each headland, and was about the first to do so. By this means he avoids stoppages. He has also introduced two small wheels in the framework of the snatch-block to facilitate its transport. To prepare for roots, the wheat-stubble is broken up by steam in the autumn, then manured, and ploughed with horses. The remaining operations depend upon the state of the weather. A plough is "much wanted," so that the engine may be at work when the cultivator cannot be used.

Cost of Work.—This is estimated by Mr. Barton at 6s. an acre, besides interest and depreciation; of this sum, rope costs 1s., and "other repairs" 1s. per acre. An average year's work is about 400 acres of tillage. The first rope was bad, and cost 1s. 6d. per acre. The manual and horse labour costs—

	£	s.	d.
Engine-man	0	3	0
Windlass-man	0	3	0
Ploughman	0	1	2
2 anchor-men	0	3	4
3 boys	0	2	2
Water-cart, boy and horse	0	3	2
	<hr/>		
	0	15	10
Oil	0	1	0
Coal	0	8	6
	<hr/>		
	1	5	4

N.B.—The men work now by the day. The first 2 years they worked by the piece, 2s. 6d. an acre divided amongst them, but they could not agree. Consumption of coal, per day of 10 hours, 10 cwt.s. = 7s. 3¼d.

Mr. Barton thinks that the possession of 300 acres of such land as he farms would justify a man in attempting the use of steam. The horses he sold gave him more than £100 towards his apparatus. Something more might be realized by the sale of implements displaced. He uses carts for harvest, and does not need more than 8 to secure it. The corn is stacked in the field. The live stock kept the year round consists of 500 head of sheep and 75 to 100 dairy cows.

LANCASHIRE.

MR. HORROCKS, GREEN BANK FARM, TONTETH PARK.

LIGHT LAND.—Mr. Horrocks, who, with his brother, on some 260 acres of variable land, chiefly light, in two occupations, has worked Howards' tackle, consisting of a 12-horse-power traction-engine by Roby, grubber, with harrow and 3-furrow plough, since October, 1863, and spoke with enthusiasm of the results. The cost of the whole apparatus was £700. The only addition has been 300 yards of rope, not because the original ropes were worn out, but because greater length was desirable. No account of repairs has been kept, but they have been inconsiderable. The fuel consumed is about half a ton daily. The average work is 5 acres of ploughing, and 6 of grubbing. The greatest depth 9 to 10 inches. Seven hands are employed, at a cost of about 17s. 6d. a day; 5 horses have been put down on the two farms and we thus judge, that in this case, although the acreage is too small to allow of very decided results, no loss has been sustained.

No journal being kept, it is impossible to arrive at accurate facts, but Mr. Horrocks is perfectly satisfied with what has been done, and has found the drainage decidedly improved. The crops have increased considerably. He considers the steam-plough suitable for all operations, and prefers the "round-about" to direct traction, inasmuch as work can be commenced sooner after rain. Last autumn Howards' tackle was ploughing whilst Fowler's was idle, on account of the difficulty of travelling the engine.

LANCASHIRE.

MESSRS. NICHOLSON, KIRKBY THORE.

HEAVY LANDS.—We could have wished for more than a scanty two hours, for this interesting case of steam as an auxiliary to horses. However, thanks to the kindness and excellent arrangements of our hosts, we were enabled to take rather more than a bird's-eye view of one of the best-managed enterprises we have seen. Situated on rising ground, 350 feet above the sea, and lying between the Crossfells (whose snow-covered sides stood out in bold relief) and the lesser ranges of the lake district, this holding presents difficulties of climate which are successfully combated; and any deficiency on this score is amply compensated for by the fertility of the soil, which may be described as a rich clay loam on the new red sandstone, interspersed with boulder-stones evidently brought down from the neighbouring mountains. The subsoil is generally strong clay with occasional beds of gypsum, which are worked both as a manure for clover and also for commercial purposes. The Messrs. Nicholson occupy two adjacent farms—one the property of Lord Lonsdale, the other partly their own land—in all 780 acres. The former was entered upon six years since, and was at that time in a very neglected state. A field was pointed out where a great crop of wheat—some 60 bushels per acre—had been reaped last harvest, which on entry was in such a poor state that the landlord would only charge for seed and cost of sowing. The whole farm has been drained under Mr. Parke's superintendence, and the old story holds good—the pipes are far too small. Some 18 acres of bog-land have been reclaimed by the tenants, and an excellent job

made of it, and very complete farm-buildings erected; the haulage having been entirely done by the tenant. Besides all this, Messrs. Nicholson trade in gypsum, which is ground and led to the railway and other places. All this explains the reason why draft horses have not been put down to any considerable extent.

It is always interesting to inspect improvements so evidently profitable as those at Kirkby Thore. Without disparaging the exertions of those amateurs who often lay out largely for the benefit of the less affluent, we cannot but avow the conclusion that such a farm as this must do better service to the progress of steam culture than any amount of eccentric and often wasteful expenditure. The practical farmer (whose interests the Royal Agricultural Society must ever have in view) will be satisfied by a visit to Westmoreland, that steam culture, in the hands of an intelligent man, may prove a good investment. Mr. J. Nicholson, being one of the Inspection Committee, had not filled up any schedule, and was not prepared with figures; our report is therefore shorn of statistics. Still we trust sufficient has been gathered to indicate the result, and we have only to add that as practical men we express great satisfaction at all we saw.

Messrs. Nicholson invested in Howards' tackle in May, 1863, to be worked by an 8-horse-power engine (Clayton & Shuttleworth), which they already used for thrashing, &c. The tackle consists of windlass, cultivator, and drag-harrows.

The total cost, including the engine, may be put at £510. The repairs have been trifling, and chiefly done at home; the engineer, filling up his time as farm-blacksmith, looks after little failings. *No rope has yet been renewed.*

Hitherto cultivation or grubbing only has been attempted; but the experience of last autumn, which was too wet for such operations, has shown the desirability of adding a 3-furrow plough; and it is under consideration to make this addition, and at the same time to get more power, and probably introduce a 12-horse-power traction-engine. The 5-course rotation is adhered to with slight deviations, seeds being grazed for 2 years. There are 500 acres of arable land, consequently 100 acres of fallow crop, *for which alone* steam cultivation is employed. Here, again, we find experience pointing out the portion of the course for which steam-culture is most suitable; the deep grubbing once in a course being found sufficient, it practically assumes the character of an auxiliary and relief to horse-labour in the heaviest operations. The fields are neither rectangular nor sizable, varying from 10 to 50 acres, and are more or less undulating. The climate is very moist, and hence Messrs. Nicholson considered that a stationary engine working a windlass would prove more suitable than the traction principle. Originally the farm was much more subdivided; miles of fences have been grubbed. We have alluded to the boulder-stones; these are removed before the steam-tackle is worked, the ploughmen sticking up sticks where they exist; men follow and get them up.

The labour consists of

An engineer, who is also farm-smith	...	...	...	...	3s. a day.
Men at windlass, cultivator, and anchors, 4 at 2s. 6d.	...	...	...	...	10s. "
Porter-boys, 2 at 1s.	...	...	...	...	2s. "
Half-tine water-cart, say	...	...	...	...	3s. "
					<hr/> 18s. "

At the present time 6 pairs of very fine horses are kept. Messrs. Nicholson consider that the cultivator relieves the farm of 3 pairs of horses; but, for reasons detailed, this is rather an approximate estimate than an actual result. The ordinary operations on the fallows are as follows:—Autumn and spring grubbing; the drag-harrows being worked a double-time before and after the spring cultivation; estimating the dragging as equal to one cultivation, we have 400 acres worked; a very moderate estimate. This, at an average of 5 acres a day, gives us 80 days as the time at work. The engine does all the thrashing, chaff-cutting, sawing, etc. Upon these imperfect data we may venture to make a calculation.*

Cost per Day.

	s.	d.
Labour	18	0
Coals and oil	7	0
Repairs	4	0
† Wear and tear, and interest on £100, at 12½ per cent.	12	6
	<hr/>	<hr/>
	£21	6

Or, per acre, 8s. 3½d.; very reasonable for such work; and if 6 horses are really saved, we should find a hand-some balance in favour of steam merely as to first cost. Now let us see as to results. Messrs. Nicholson, having so recently drained, cannot speak positively of the effect on drainage; they find, however, that the succeeding operations by horses are decidedly lightened—an evidence of a deeper soil and more even bottom. Roots can now be fed off more easily for two reasons: no horse-treading to cause a pan, and the whole surface is moved, which is not the case with horses. We quote Mr. J. Nicholson's reply as to increase of produce.—“Yes, no doubt of it.” The clover-seeds are decidedly more certain, and the produce increased. We saw a remarkably promising show of seeds. With a 3-furrow plough and a more powerful engine—extra outlay which the success of the past fully justifies—Messrs. Nicholson's steam culture will be more valuable than it has proved as yet. We may add that Mr. J. Nicholson was loud in his praises of the drag-harrow, with its chisel-pointed tines, and we can readily believe that to follow the grubber it will prove a very valuable implement.

LEICESTERSHIRE.

LORD A. ST. MAUR, HOME FARM, WALTON.

HEAVY LANDS.—At Lord A. St. Maur's Home Farm, at Walton, Howards' apparatus has been at work since 1862, and is well spoken of by Mr. Mountstephen, the bailiff. We have a 10-horse-power engine, by Clayton and Shuttleworth, 5-tined cultivator, chisel-harrows, and 3-furrow plough—the latter being found particularly useful in a season like the last. The expense of repairs has been absurdly small. The engine has never cost a shilling, and the bailiff would undertake to keep the whole concern in order for £10

* Messrs. Nicholson state that the average quantity of work per 10 hours varies from 5 acres twice over to 8 acres once in a place, and with the harrows 15 to 20 acres have been accomplished.

† £110 is deducted from outlay, for value of engine for other purposes than steam cultivation.

a year. One new rope (800 yards) was bought last autumn, and the remainder has been renewed since; so we can easily calculate the wear and tear of ropes from 1862 to the end of 1866.

The farm contains 600 acres arable and 200 pasture: the soil is a strong clay, on limestone. It is farmed on the 4-course. Thus we have 150 acres for roots, either ploughed or cultivated in autumn—in spring twice cultivated; 150 acres for wheat, after seeds, beans, and fallow, either ploughed or cultivated by steam; 150 acres for spring-corn, ploughed or cultivated. The average daily work, ploughing or cultivating, is calculated at 5 acres, including shifting. The number of days' working were, in 1865, 72 days; in 1866, 97 days. From this it is evident that about 364 to 480 acres represents the work done, and it is equally clear that a considerable portion of the tillage-work is still done by horses:—

	£	s.	d.
Wages	0	15	2
Water-cart	0	3	0
Coals, 7s. 6d., and oil, 1s. 6d.	0	9	0
Repairs £10	0	2	6
Wear and tear on £638, 7½ per cent.	0	12	0
Interest of money, 5 per cent.	0	8	0
	2	9	8

Assuming 80 days as the yearly average, we have an annual cost of £198 13s. 4d. Formerly 24 horses were kept to do the ordinary farmwork—now only 12 are so used; and here we may notice a fact which was constantly brought before us, viz., that the area cultivated by steam does not represent the acreage that would be worked by the horses displaced, evidently showing that by the use of steam the number of operations is greatly reduced, one thorough piece of work by steam-power proving more effective than several horse-operations. The annual cost of these 12 horses would be £600, consequently at the present time there has been an annual saving of £387 6s. 8d.

Calculating that 2000 acres have been worked by steam from 1862 to 1866 inclusive, and that the original ropes (1600 yards), costing £69, were worn out at the latter date, the expense of rope has been 8½d. an acre, which agrees very closely with the most successful cases on strong land that came under our notice. The surface is generally undulating; the fields average from 15 to 16 acres, and are well adapted for steam culture—in many cases 40 to 45 acres can be worked without moving the engine. The soil is a sticky limestone-clay, difficult to work by horse labour. The effects of steam culture have been very evident in an increased produce; in the case of corn fully 6 bushels per acre, whilst root-crops are grown over a larger area and give a better yield. This satisfactory result is attributed to greater expedition attainable in catching seasons, more thorough exposure of the soil to atmospheric influence, and more perfect drainage. The clover-crops, which are grown every eight years, are greatly improved, the plant less liable to fail, and the produce increased. This is accounted for by the surface being more friable. A much heavier stock is now kept: 310 ewes are put to the ram, the lambs being sold in autumn, whilst 50 head of cattle are grazed in summer and 80 in winter. Mr. Mounstephen considers the effects of steam culture so beneficial, that he

would not hesitate, if occupying the farm as tenant, to take the apparatus at a valuation. It is his opinion that 300 acres arable is the minimum area on which steam could be profitably employed, supposing that the engine is used for thrashing purposes. Last year an adjoining farm was taken in hand in a very neglected state: at the period of our visit, drainage-operations were in progress, and steam will undoubtedly prove of great service in the improvements that are contemplated. We cannot leave this case without expressing our opinion of its highly successful character and importance as an instance of the profitable application of steam under good management.

LINCOLNSHIRE.

MR. FRANCIS SOWERBY, AYLESBY, GRIMSBY.

LIGHT LANDS.—Mr. Francis Sowerby, of Aylesby, Grimsby, Lincolnshire, occupies 650 acres arable, and 250 acres grass, in the gently undulating “diluvial” or “drift” district between the chalk Wolds and an alluvial belt of marsh land next the sea. The soil is a loam, lying upon a clay subsoil, and makes rather hard pair-horse ploughing. The farm is in large fields, 20 to 30 acres each and more, having been enlarged for steam cultivation; the land is pipe-drained, and the ploughing “on the flat.” Mr. Sowerby has a Ruston and Proctor’s 10-horse portable-engine; started a “Smith” tackle in 1859, and after working it five years, exchanged it for a “Howard” set, with a 3-tined and a 5-tined cultivator, taking 3 feet and 4½ feet breadth respectively, to which he has since added a set of steam harrows. His reason for “giving up Smith” was because he found “once over with Howard to be not quite but nearly as good as twice with Smith.” Here we see what different conclusions are obtained upon different soils: for Mr. Randell, considers the Woolston grubber inimitable for breaking up a clay, while the Bedford tool is better for crossing already-tilled ground. Mr. Sowerby considers 5 acres to be a fair day’s work with the 3-tined implement; for which his 5 men and 3 boys earn their regular wages,—engine and windlass-men 2s. 9d. each, ploughmen and two anchor-men 2s. 3d. each, and three boys 1s. each. For all work over and above 5 acres in a day, the gang gets 3s. per acre. Carting about 1000 gallons of water per day costs 2s. 6d. for the horse; oil costs 2s. a day; and half a ton of coal, at 14s. 6d. per ton, including carriage, 7s. 3d. a day. Removal, with no fewer than 10 horses and 2 extra men, occupying about four hours, say once a week (as Mr. Sowerby “sets down” to very large plots at once, one field of 48 acres being done from the engine stationed “midside”), will cost about 2s. 6d. on each day’s work. We should say, however, that a cheaper plan for moving is for four horses to take the engine, two returning to fetch the windlass, and two to fetch the rest of the tackle. These items, collected together, are—

	£	s.	d.
Manual labour	—	0	15 3
Water-cart horse	—	0	2 6
Removal	—	0	2 6
Oil	—	0	2 0
Coal	—	0	7 3
Working expenses per day	—	1	9 6

Mr. Sowerby estimates his wear of rope at 8*d.* per acre. He contracts for blacksmith's work, and finds it difficult to arrive at the exact cost of repairs; but he thinks that 15 per cent. per annum upon prime cost will cover the several items of repairs, wear and tear, depreciation in value, and interest of capital invested. The apparatus cost above £250; the share of the engine, which is employed nearly half its time in thrashing the produce of about 300 acres of corn, may be valued at, say, £180; and 15 per cent. on £330 will be £49 10*s.* a year. For the last four years, the apparatus has worked seventy-eight days in each year; thus making the charge 12*s.* 8*d.* per day. The whole expenditure, then, is as follows:—

	Per Day.		Per Acre.	
	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>
Working expenses	29	6	5	10½
Rope	3	4	0	8
15 per cent. for repairs, wear and tear, depreciation, and interest	12	8	2	7
Total	45	6	9	1½

Of course, the larger acreage per day done with the 5-tined cultivator would cost something like two-thirds, or say, 6*s.* per acre. This does not look like very cheap work, if we compare it with the price at which horses can cultivate; but that the steam work is really worth far more than horse work would have been, may be very easily perceived. In the first place, it has enabled Mr. Sowerby to sell off 6 out of his former force of 24 horses, and moreover, to bestow less "keeping" upon the remaining 18—which are found amply sufficient to get up his harvest well with the big, old-fashioned pair-horse wagons of the country. Six horses, at our standard estimate of £44 each, for maintenance and working, save £264 a year: the annual outlay for steam cultivation is about (78 days × £2 5*s.* 6*d.*) £177 9*s.*; leaving a gain of £86 11*s.* *plus* the saving in maintenance of the remaining 18 horses. But the great thing is that there has been a decided increase in the yield of cropping since the steam-cultivator started. The drainage, too, is improved; and the root-crops are eaten off with somewhat more advantage.

As one altogether exceptional circumstance, we may mention that from the mere cleansing of one field, Mr. Sowerby considers that he gained as much as £150 in a single year. This 40-acre piece was foul; had it been ploughed, it must have become one mat of twitch; whereas, treated by the steam-engine, it gave a better crop than it had ever before produced.

Mr. Sowerby's husbandry is nearly 4-course, sometimes with 2 years seeds; but beans not grown. In autumn he breaks up with the steam-cultivator 150 acres of stubble, and crosses in the spring for green crops. The 18 horses manage the manure-carting, by getting out the dung in early winter, to be laid on the land for roots at sowing-time. Besides the 300 acres of steam-fallow grubbing, 40 to 60 acres of seed-lea are broken up in July by steam for wheat; Mr. Sowerby finding that he thus gets a good crop without weak straw. The great point in steam tillage, he says, is doing the work when dry, and he has no horses on the land from Christmas to March.

He expressed himself very well satisfied with the apparatus, and he is

one of those managers who take care of their machinery; his rope is in good order, and always "dressed" before laying by. Owing to the wet season, it had not been used since July,—this was at the time of our visit, November 12th.

LINCOLNSHIRE.

MR. JOHN SOWERBY, JUN., BEELSBY, GRIMSBY.

LIGHT LANDS.—Mr. John Sowerby, Junior, of Beelsby, Grimsby, has two farms under steam culture, embracing 1200 acres arable, and 300 pasture; partly strong soil upon clay, and partly light, easy, pair-horse land, upon marl. Most of the arable is level, but a small proportion is light. Wold soil on the hills, and worked chiefly by horses. The fields are of 35 to 40 acres each. In the summer of 1864, Mr. Sowerby purchased a set of Howard tackle, for £250, being induced to do so by the success of a similar set in the hands of his uncle, Mr. Francis Sowerby; and in the spring of 1866, a double-cylinder 10-horse engine for £270, before which time an 8-horse engine had been used, and found too weak. No repairs of consequence have been needed, the rope has broken a few times, two or three snatch-block pulleys have been fractured by the engine-man not stopping in time; and the rope-porters worn have been repaired by a blacksmith. The engine is used for thrashing out the grain off 250 acres, but the apparatus is not let out on hire. The cultivator does from 5 to 8 acres a day, the hands being paid 3s. an acre when working the "3-tiner," and 2s. 3d. an acre when working the 5-tiner; the force being five men and two boys, besides the water-boy; removal takes 10 horses and occupies three hours. The water carted is about 1300 gallons, the oil costs 1s. 3d., and half a ton of coal costs 7s., besides carriage 7 miles.

About 57 days' work was done in the autumn of 1865 and spring of 1866, and the "days put off by bad weather or by breakages" have been few. Of course, it is too soon yet to judge of effects upon cropping. The stronger soil drains better, and Mr. Sowerby has disposed of 6 out of his former force of 40 horses.

MONTGOMERYSHIRE.

MR. HENRY HANBURY TRACY, OF GREGYNOG HALL, NEWTOWN.

HEAVY LANDS.—Mr. Henry Hanbury Tracy works a Howard tackle, with 5-tined cultivator and ridging body, a heavy steam-harrow, light harrow, and side harrow, by a 10-horse portable engine, upon only 106 acres arable. The soil is a "mixed heavy loam, hard and tenacious," "hilly," and now divided into seven fields, ranging from 7 to 30 acres—all altered to suit steam cultivation—and roads have been made for bringing the engine to each "station," while at each "station" a reservoir has been constructed, so that the engine pumps its own water. The repairs have been "£5 or £6," chiefly from breakages. The average performance is about 6 acres cultivated per day. A removal takes 6 horses, "on the average," "from a day to a day and a half." When taken in hand, this farm was in "a most wretched, neglected state:" "4 horses will now do all the work required [except the

removals!]; but it would take three times the number to do what we now do by steam." Much of the ground having produced nothing before, except gorse, thistles, and rushes, it is impossible to assign any increase of production to the steam work.

NORFOLK.

MR. J. L. KING, THORPE HALL, SCOLE.

HEAVY LAND.—Mr. King, being unavoidably absent, kindly provided a substitute, who did the honours of his house, conducted us over the cleanly, well managed farm, and gave us all the information in his possession. This gentleman, Mr. Bate, of Shimpling Place, Diss, having taken great pains to collect reliable data on the question of steam cultivation to lay before a neighbouring Farmers' Club, had watched the process conducted on Mr. King's farm with great closeness, and for one year had obtained a daily return of the work done, for the purpose of comparing the result with that obtained by Mr. Cooper and others.

The farm consists of 660 acres—grass, 54; wood, 40; arable, 560, two-thirds heavy, one-third light and mixed. Three horses plough 3 roods a day, 6 inches deep, on the heavy land. The subsoil of the stiff land, which is drained 4½ inches deep and 7 yards apart, is an adhesive brick-earth, mixed with stones; that of the light land is a gravel. The farm has been 16 years in Mr. King's occupation, and is farmed on the 4-course system. He hires the land of Mr. Holland, of Bedham, near Saxmundham, who has granted permission to straighten fences, enlarge fields, &c., and something in this direction has been done. The fences are not *irregular*. The largest field was one of 19 acres, the smallest one of 6 acres. We were informed that great benefit had been derived through the drainage having been rendered more effective after the soil had been deeply broken up by steam: also from the larger area of root-crop obtainable, the heavier crops harvested, and the ability acquired by the land to carry sheep without injury. As to sheep, the advantage is felt on the heavy land being so soon ready to receive them after rain. It may also be mentioned that, while they are putting in barley in that district during March and part of April on the heavy land, it is of the utmost importance that the fallows should be forwarded at the same time; and this, during his use of steam, Mr. King has been able to accomplish. The land which was in ridge and furrow now lies on the flat; the stubbles over which we walked indicated heavy crops, and crops free from weeds. The turnips and mangolds were very fine; and have generally been far more certain since steam has been employed, simply because the season has been caught and properly used. The failure of part or the whole of a root-crop is frequently due to the absence of the supplemental power of which Mr. King has availed himself. The number of horses was 20; it is now 15. This gives 2 horses to 75 acres arable—too many, as we ventured to remark. It was explained, however, that a new farm of 106 acres was in expectation, which would be worked with the same power as that now in operation. The teams, of course, have less work, and are maintained in as good condition at less cost; indeed a greater reduction has been thus effected than in the number

of horses kept; instead of 7 stones of meal per horse, he now gives 5. On inspecting the account of labour done, it will be seen that the possession of so many horses has proved a strong temptation to let the tackle rest. That only 217 acres were once cultivated between the autumn of 1865 and the spring of 1866, inclusive, is proof sufficient that steam had not often been got up. It was contended that the 300 acres of grain usually cut and stacked could not be harvested with less than 14 horses, which, in order that they may be in readiness, must have work found for them the rest of the year. We maintained that, provided the corn was stacked in the field, and 1-horse carts used, 11 horses would suffice—9 for as many carts, 1 for a horse-rake, and 1 for a water-cart. The habit is to use 7 carts and 2 wagons. It is difficult to discover the avowed impossibility of supplying any additional need when the need was felt, and then of reducing the power to its previous dimensions. When horses are kept, the prevailing feeling is that they must be employed; it would not do to see the steam-engine puffing away, and the horses looking over the strawyard-gate at it, so the engine rests. But this course is frequently bad policy, for it would often prove better to spare the horses and work the engine. The addition of a plough to turn over the clover-leys would enable this gentleman to reduce his horse-power still further.

Mr. Bate is of opinion that none but the roundabout tackle and stationary engine is applicable to that part of the country. He spoke of many obstacles to the progress of steam-tillage, particularly on the heavy soils, the fields being very small, the boundaries irregular, and cumbered with trees, which straggle even into the fields, which vary in size from 3 to 12 acres. Yet they are bigger than they were thirty years ago. If steam cultivation were more generally introduced, he had little doubt that the landlords in this district would allow the removal of many of the trees, and of the unnecessary hedgerows. There seems now to be a disposition to make these fields larger, and to introduce steam.

No special provision has been made for water, which is found in ponds, and is of good quality.

The *Apparatus* was bought in 1862 of Messrs. Howard, the engine of Mr. Burrell. It consists of—

An Engine of 12-horse power, double cylinder, traction, made by Burrell, which is used in thrashing, abroad and at home, grinding and chaff-cutting	£ s. d. 450 0 0
A windlass, cultivator, snatch-blocks, porters, and 1600 yards of rope, made by Howard	236 7 10
A Cultivator on Mr. Cooper's model, made by Burrell	35 0 0
	<hr/> 721 7 10

Repairs, Renewals, Wear and Tear.—The repairs of the engine have been very slight; there is a good engine-shed, and a careful engineer, who keeps the engine in a very creditable state, and escapes breakages and wear which those ever incur who see what is amiss too late to remedy it without great cost. He is provided with a portable forge and vice. The mud-holes are cleaned weekly. The rope broke four times with kinks. It has been working four years, and will last the fifth. The frame of Howards' cultivator has been pulled out often by tree-roots. On Cooper's there has been no outlay. The windlass was in a good state; all has been carefully used. The apparatus was not at work. Mr. Bate bestowed great praise on Cooper's cultivator.

At the close of 1863, Mr. King made a careful computation of expenses, which was published. Before quoting from the statistics which were placed in our hands, we deemed it prudent to write, requesting to know whether his present coincided with his past experience. He replied, "When I first commenced steam cultivation, I paid great attention to every part of the apparatus, and found that I must charge for engine, 10 per cent.; rope, 20 per cent.; windlass, snatch-blocks, &c., 5 per cent.; and after four years' experience, I do not consider that I have made an excessive charge for wear and tear."

Mr. King's capital account shows how both wear and tear and interest are computed to fall upon the several parts of the apparatus:—

			Wear and Tear per Cent.	Charge for Wear and Tear calculated per annum.	Interest per Cent.	Charge for Interest calculated per Annum.
	£ s. d.	£ s. d.		£ s. d.		£ s. d.
Engine ... ..	...	450 0 0	5*	22 10 0*	2½*	11 5 0*
Windlass	65 0 0					
Double Snatch-blocks... ..	12 0 0	128 5 0	7½	9 12 4	5	6 8 3
Cultivator	21 0 0					
Porters	13 15 0					
11 ditto	16 10 0					
6 snatch-blocks	18 0 0	42 2 10	7	3 10 9	5	2 8 1½
3 anchors	10 0 0					
Sundries	14 2 10					
Rope ... ..	...	60 0 0	20	12 0 0	5	3 0 0
		680 7 10		47 13 1		23 1 4½

Mr. Kersey Cooper has entered into a similar calculation. The report of his experience will follow the present; but, for purposes of direct comparison, we prefer here to insert a similar extract from his capital account:—

			Wear and Tear per Cent.	Charge for Wear and Tear calculated per Annum.	Interest per Cent.	Interest calculated per Annum.
	£ s. d.	£ s. d.		£ s. d.		£ s. d.
Engine	420 0 0	5	21 0 0	2½	10 10 0
Snatch-blocks	17 10 0	120 13 0	7½	9 1 3	5	6 0 6
Windlass... ..	40 0 0					
10 porters	7 10 0					
14 rollers	3 10 0					
14 ditto	2 16 0					
5 anchors	10 0 0					
4 ditto	7 10 0					
Cultivator	20 0 0	80 0 0	20	16 0 0	5	4 0 0
Porters	10 0 0					
Sundries	1 17 0					
Rope	620 13 0		46 1 3		20 10 6

* One-half the wear and tear and interest of engine, the other half being charged to other work.

The Work done and the Method.—Working with an average of 60 lbs. steam-pressure, 10 hours a day, including removals and stoppages:—

From the autumn of 1862 to the spring of 1863, 394 acres were once cultivated from 7 to 7½ inches deep, in 55 days, which is equal to 7 acres a day.

From the autumn of 1863 to the spring of 1864, 315 acres were once cultivated from 7 to 7½ inches deep, in 46 days, which is equal to 6¾ acres a day.

From the autumn of 1864 to the spring of 1865, 217 acres were once cultivated, but in what number of days was not ascertained.

A harrow was used behind the cultivator during a wet part of the season, and worked well at a time when it would have been too wet for horses. In preparing for mangolds, it is Mr. King's practice to cultivate twice in autumn, to manure in winter, to plough on the flat with horses. Sometimes he cultivates once with steam 7½ inches deep, ploughs with horses, and manures and ploughs in spring. On this subject Mr. King expresses a very strong opinion. He says that one cultivation or breaking up on his heavy land answers better than two; it leaves the land more open for winter influences. This one is followed by a stirring in March, and again in the end of May or the beginning of June. The total cost in this case, allowing for harrowing, was £1 4s. an acre in 1863. It is a noticeable fact that the same year a practical valuer gave from his book three examples of charges allowed by him for fallowing, viz.:—No. 1, £2 11s. 10d.; No. 2, £2 12s.; No. 3, £2 13s. In a letter dated November 24, Mr. King states that the cost for similar work, during the past year, has been £1 15s. In 1864 he made a fallow of 86 acres for £1 12s. 9d., steam and horse-power included; and of 24 acres of light land for £2 3s. 9d., by horse-power alone. Now that he has abandoned one of the two autumn stirrings, the first amount, which includes both, would be reduced to £1 4s. 1d. Mr. Kersey Cooper's fallows on 45 acres of light land, in 1864, are stated to have been prepared at a cost of 19s. 4d. an acre (10s. being deducted on account of expenses connected purely with the rye-crop which preceded the roots):—

Cost of Work.

Manual and horse-labour:—							£	s.	d.	
Engine-driver	...	...	...	...	...	...	0	3	6
Windlass-man	...	...	...	...	...	...	0	3	0
Ploughman	...	...	...	...	...	...	0	1	8
2 anchormen	...	...	...	...	...	...	0	3	4
3 boys	...	...	...	...	...	...	0	2	0
1 boy and horse	...	...	...	...	...	...	0	3	6
								0	17	0
Coal	...	...	...	...	...	...	0	12	6
Oil	...	...	...	...	...	...	0	1	0
								1	10	6

N.B.—Coal, 17s. per ton, home; consumption, 15 cwts. per day of 11 hours.

The quantity of work done between the autumn of 1863 and the spring of 1864 amounted to 315 acres. The aggregate expenses and the expense per acre are as follows:—

	Aggregate.		Per Acre.	
	£	s. d.	s.	d.
Manual-labour, coals and oil	62	7 9	3	11½
Interest of capital, wear and tear	70	14 5½	4	5½
Horse-labour for carting water, deducting } £2 6s. 10½d. for harrowing 62 acres ... }	5	1 2	0	3
	138 3 4½		8 8½	

For the sake of comparison, it may be as well here to insert the aggregate and the acreage expenses incurred by Mr. Kersey Cooper the same year. The acres worked amount to 731; depth from 6½ to 7½ inches; time, 65 days, or 11 acres per day:—

	Aggregate.		Per Acre.	
	£	s. d.	s.	d.
Manual-labour, coals, and oil	106	2 1	2	9½
Interest and wear and tear	66	11 9	1	10
Horse for carting water	6	10 0	0	2
	179 3 10		4 9½	

The difference here is due to the heavy nature of the land and the smaller area of the fields in Mr. King's case. Mr. Cooper's fences are straight, his fields are large, his soil comparatively light. By placing his 731 against Mr. King's 315, the latter is thrown up in the scale; but, beyond this, Mr. Cooper gets over more ground.

Mr. King's tackle is under no circumstances let out, lest it should either be badly used or the men dawdle when removed from the master's eye. Mr. Bate considers that it would be practicable, in the neighbourhood of Diss, for farmers of 300 or 400 acres to lay out £300 in tackle, and to hire an engine when required. In some cases, such as isolated districts, the engine would find full employment, thrashing, etc.; then, of course, the whole apparatus should be obtained.

NORTHAMPTONSHIRE.

MR. JOHN WHITE PELL, OF MANOR FARM, STANION, THRAPSTON.

HEAVY LANDS.—Mr. John White Pell, of Manor Farm, Stanion, Thrapston, Northamptonshire, occupies 500 acres of arable, and 225 acres of pasture, principally a strong clay soil upon a subsoil of limestone and clay. The surface is generally level, in fields of about 20 acres, a little altered to suit steam cultivation. His apparatus, consisting of a 10-horse portable engine, by Butlin, of Northampton, and a set of Howard's tackle, with a 3-tined and a 5-tined cultivator, cost £470 in the year 1861; the "additions" since have been one new rope, at £60, and the repairs very light, Mr. Pell having met with "no bad accidents" so as to require anything more than ordinary replacement of wearing parts. The machinery is worked about 55 days in a year, a small part of its time being spent upon three neighbouring farms, doing a few days' contract work. This has amounted to only 30 acres worked twice over (that is, 60 acres of grubbing altogether), at a charge of 22s. per acre. The engine is used for thrashing, grinding, cutting chaff, and pulping roots.

The hands required are 5 men and 3 boys, at 15s. per day; and these, when not cultivating, are employed at ordinary work upon the farm. The

water is supplied by a water-cart and one horse; the oil costs 1s. and the coal (at 16s. per ton) costs 12s. per day. Moving the tackle and setting down to work again is accomplished in 2½ hours, by the aid of 9 horses and 5 men. The average work done per day amounts to 7 acres of deep grubbing. Having been unable to visit Mr. Pell and make our own inquiries, we can form only a very rough estimate of the outlay and return in his case. Fifty-five days' working expenses (including removals) appear to be something like £116 a year; interest and depreciation, at 10 per cent. on the whole prime cost, £470, would be £47. The engine (which cost £270 out of the £470) does so much other work, that we shall not favour the steam culture if we set off this work against the "repairs," which are not stated; and we have thus a total expenditure of about £163.

Mr. Pell formerly kept 18 horses. The steam-engine has displaced four of them, and therefore the saving, valued at £44 per horse just about meets the outlay incurred by the steam-cultivator.

The gain consists in a better drainage of the heavy staple consequent upon breaking up the panny subsoil, in a considerably increased acreage of root-crop, and a better grown and larger root-produce per acre; though Mr. Pell has not found any greater facility than before in feeding-off by sheep. More roots have necessarily brought more stock and more manure, resulting in a larger yield of corn. In fact, Mr. Pell is of opinion that, by the introduction of steam tillage, his grain-crops have become more productive to the extent of 6 bushels per acre more than they were before. Such handsome results having accrued, it matters very little whether or not the steam tillage costs a few pounds more than the old horse tillage which it has displaced.

NORTHUMBERLAND.

MR. S. LANGDALE, OF HIGH ESLEY, NEAR MORPETH.

HEAVY LANDS.—Mr. S. Langdale, (a manufacturer of manures and chemical products at Newcastle, as well as an agriculturist), occupies about 600 acres arable, and 300 of pasture in three farms, High Esley, Low Esley, and Newton Red House; consisting of various descriptions of land, for the most part heavy, but with portions of light soil and gravel. Since August, 1864, he has worked a Howard tackle with 3-furrow plough, cultivator, ridging-furrow plough, and set of harrows, driven by a 10-horse engine. The prime cost, altogether, was about £800; but no account has been kept of the repairs. In fields averaging about 20 acres apiece, the cultivator does 7 acres per day of 10 hours, and more in a long day, the depth of work 8 to 10 inches; the plough turns over 5 acres a day. The ridging-body has been used with admirable effect in trenching-up cultivated fallows for winter exposure; and the harrows are spoken of as making a really wonderful tilth for a seed-bed, owing to the depth pierced by the tines and the absence of horses' feet. Indeed, we consider that this steam-harrowing is not taken advantage of by steam-plough farmers half as much as it should be. It is a great mistake to imagine that setting a powerful steam-engine to such a light surface operation as harrowing commonly is, must be trifling with a huge force—somewhat like putting a Samson to tin-tacking down a carpet

or hanging a lady's muslin curtain; for, in reality, scarcely any work of a steam-tackle gives more satisfaction than the harrowing, both from the excellence of its performance and the great area got over per day.

Mr. Langdale's 5 men cost 18s. each per week, and his 3 boys 6s. each per week; but though labour is dear, coal is cheap—the engine burning half a ton a day, at 7s. per ton. A removal is a heavy job, taking 9 horses about 2 hours, the roads being hilly, and the whole of the apparatus having to be moved at one shift from one farm to another. The engine does the “thrashing, grinding, and chopping” for all Mr. Langdale's farms; and, at different times, the tackle has cultivated on six neighbouring farms, doing the work twice over for 21s. per acre.

Mr. Langdale's brother, at Newton Red House, informed us that the land had been levelled before steam culture was introduced, and being well-under-drained lies pretty dry, owing to the steam tillage leaving it so light. They have no dead-fallow; always get turnips and potatoes, and have now been enabled by steam to considerably enlarge their breadth of roots. The crops, generally, have been more productive, and Mr. Langdale says, “I find manures to act better:” this being precisely accordant with the general experience that artificials give their greatest effect only in finely-worked mould, which cannot be obtained in perfection on strong land except by steam-driven implements. Mr. Langdale formerly employed 27 horses, which he has now reduced to 20, and these are kept at less expense per head.

The tilling-machine is always at work during the proper season, except in wet or bad weather; and its owner is warmly in its favour as an economiser of time and expense, a promoter of the growth of equable crops, and the means of making both clay-land and lighter-land farming remunerative.

NOTTINGHAMSHIRE.

MR. FISHER, ORSTON, ELTON.

HEAVY LANDS.—Mr. Fisher shows what can be done on the strongest description of lias-clay; not so much in the way of reducing horse-power, as in allowing an alteration of cropping with a view to an increased sheep stock. Before steam cultivation, root-crops were unknown; the bare fallow prevailed, and the sheep were wintered out: now mangolds and cabbage are largely grown and consumed by the sheep in yards, whilst spring vetches occupy a considerable breadth of the fallows, and are eaten off early in autumn, in time for a bastard fallow. The farm contains 700 acres, half of which is arable. The apparatus consists of 10-horse-power engine, by Clayton and Shuttleworth, and Howards' windlass and 5-tined cultivator, etc., costing £550. Mr. Fisher being from home, we were unable to obtain any statistics as to the cost of repairs. The principal work appears to be the autumn cultivation of the fallows and preparation of bean-land; a considerable acreage of *winter beans* is sown, and we may fairly say that their growth would be impossible without steam. The cultivator is seldom used in spring; its first task being on vetch-stubble, which is thoroughly worked in preparation for wheat. The seeds are always broken up early (before

harvest), and receive 2 cultivations for wheat. In 1866—which was a very unfavourable season for cultivation—102 acres were worked, and we may estimate the average annual work at 200 acres. The question naturally arises, Would not a 3-furrow plough have proved a valuable addition, and been amply paid for by the reduction of 2 more horses? At present, Mr. Fisher has only taken off 4 horses, keeping 10 now instead of 14. Our experience, especially upon strong land, leads us to the conclusion that it is desirable to be able either to cultivate or plough; for, although in a dry season the former work is most advantageous, it is of great importance to be able to plough in such a season as that of 1866.

We walked over the farm and inspected the crops and stock, and have seldom seen strong land in such a healthy and fertile state. The fallows were dry, the wheat strong and tillering, and the mangolds large, and the whole farm particularly clean. The land is all drained efficiently, and decided advantage has accrued from steam culture, in a drier, healthier surface. The alteration of croppings rendered possible by steam culture has been already touched upon, but it is so important and prominent a feature on this farm that we must allude to it again. Granting, for the sake of argument, that the corn-crops are not materially increased; granting that the roots cost as much as they are worth; still the drawbacks from shifting a flock, with either change of ownership or loss of proper supervision, is very detrimental to the breeders, whilst to consumers the benefit arising from increased production is evident. But we are inclined to believe that the judicious growth of roots and vetches must result in an increased corn-produce. In confirmation of this view, we have the evidence of an attentive critic, who was at first greatly prejudiced against the apparatus, but, from observing results, has now entirely changed his opinions, and tells us that he never before saw 160 acres of wheat so even and productive on any one farm, and the appearance of the stubbles that are still open bears him out. We found the ewes running at large on the grass-land, whilst the hogs were living in open straw yards, and eating pulped mangolds and chop, consisting of peas and oat-straw with cotton-cake. All the stock looked well.

NOTTINGHAMSHIRE.

MR. HEMSLEY, SHELTON, NEWARK.

HEAVY LANDS.—The question—an important one—is often put, What is the requisite size of a farm to ensure a profitable result? Our visit to Mr. Hemsley, Shelton, Newark, tended to elucidate this point. The occupation now consists of 206 acres*—138 arable and 68 grass. The soil is a clay-loam resting on red marl—a very fertile soil, naturally sufficiently tenacious to grow wheat and beans, and yet not too strong for root-crops, though the latter are somewhat difficult to eat off. We have said that the soil is naturally fertile; its productive powers are stimulated to the highest degree by very forcing treatment—a large quantity of cake and corn are consumed, an immense head of stock kept, and great crops of corn grown—so that in reality the

* At the date of purchase, Mr. Hemsley occupied 170 acres in addition to his own farm, which it was contemplated to cultivate.

produce represents a much larger area, according to ordinary management. The fields vary from 10 to 25 acres, averaging about 14 acres. That it is possible, under such circumstances, to employ steam cultivation without an actual loss, depends upon the economical and constant use of the engine for other purposes—thrashing, driving barn-machinery, etc. This is done at Shelton in a manner which it would be difficult to improve upon.

Mr. Hemsley uses Howards' apparatus, consisting of windlass, cultivator, 1400 yards of rope, etc., and Tuxford & Co.'s 10-horse double-cylinder engine. The engine was bought in 1858, in anticipation of steam cultivation which was not commenced till the autumn of 1862. The wearing properties of the engine are highly spoken of, the repairs have been moderate, not a new bearing has been required, and the wearing parts are as perfect now as when turned out. One great reason for this satisfactory condition of things is, that the pressure of steam is never allowed to exceed 60°, it being considered better to reduce the work done by taking less ground, rather than overtax the engine.

Owing to the small area, the cultivating-apparatus is little the worse for wear. The original rope is still in use and likely to last for some years, and no serious breakage of any kind has occurred, nothing more than the occasional overturning of a porter and the necessary wear of the rope. The cost was

Engine	...	...	...	...	£ 300
Apparatus	...	...	...	...	200
					<hr/> 500

The only articles from the manufactory are points, the cost of which will not exceed 3d. an acre. The average work per annum has been from 100 to 120 acres, partly with 3 and partly with 5 times in the cultivator, and mostly twice in a place, *i.e.* 50 to 60 acres of surface. The steam is almost entirely confined to autumn cultivation. Here, as at Sutton, it is found desirable in the case of the fallow-land to throw the surface into deep ridges before winter, and *the fine surface is never again buried*. In 1866, notwithstanding the season, the apparatus was at work 14½ days, during which 55 acres were twice stirred, making 110 acres, at an average of 7½ acres a day; the cost per day as follows:—

Labour:—						£ s. d.
Engineer	...	...	...	...	...	0 3 4
2 anchor-men, at 2s. 6d.	...	...	...	...	...	0 5 0
1 ploughman	...	...	...	...	...	0 2 6
Windlass-man (one-armed)	...	...	...	...	...	0 2 0
2 boys, at 8d., porters	...	...	...	...	...	0 1 4
1 boy partially employed pumping from wells	...	...	...	...	...	0 0 6
						<hr/> 0 14 8
Coals, ½ ton, at 15s.	...	...	...	...	...	0 7 6
Oil	...	...	...	...	...	0 0 6
Repairs, estimated at	...	...	...	...	...	0 5 0
* Wear and tear on £260 at 7½ per cent.	...	...	...	...	...	1 6 10½
Interest on £260 at 5 per cent	...	...	...	...	...	0 17 11
						<hr/> 3 12 5½

According to the above figures, the annual cost of steam cultivation

* This sum of £260 represents the cost of the cultivating machinery, plus ½ of the engine. The remaining ¼ being charged to the various departments for which steam is continually employed.

amounts to £52 11s. or 9s. 6d. per acre. On so small an area it has not been possible to materially reduce the number of horses kept, and we think it must be conceded that where there are only 5 or 6 horses, steam cultivation will not prove economical in this respect; but the neck of the work is broken, operations are performed that horses could not effect, expedition is ensured at seasons when despatch is all-important, and alterations are made in cropping, especially with regard to the fallow-crops, which could only be effected, without steam, by extra horse-power; and it is not too much to say that to obtain stolen crops of vetches, to be followed by turnips—to properly cultivate so large a proportion of cabbage and mangold as is required for the large head of sheep-stock and cattle that are wintered—one additional horse would be required, and the cost of this horse would fully equal the cost of steam culture. The question, then, to be solved is, whether this outlay has been justified by improved produce. Having carefully inspected this farm, we are prepared to state that we have never seen land cleaner or in higher condition, and an extraordinary head of stock is kept. Thus on the 206 acres, 152 Lincoln ewes are lambed down, and the produce sold out at 20 months old, and about 60 head of cattle kept. Such a favourable result on so small an area is only rendered possible by the economical use of steam-power for other purposes; and we come to conclusions that Mr. Hemsley's experience is too exceptional to build upon, and that from 250 to 300 acres of arable land is the smallest area on which it would be prudent to employ steam cultivation. In draining this strong soil Mr Hemsley has made several wells, 4 yards deep, at convenient spots, to do away with the expense of carting water. These wells cost 30s. each, are covered with a square stone, and are simple and practicable, not only valuable for steam cultivation and watering cattle in summer, but of benefit to the drainage as reservoirs for silt and air-holes.

NOTTINGHAMSHIRE.

DUKE OF PORTLAND, CARBURTON.

LIGHT LANDS.—These water-meadows, comprising 500 acres, laid out on the catch system, are probably the most perfect of their kind in the country. The water is collected in a reservoir of 80 acres, situate on the other side of the town of Mansfield, which receives the sewage of Sutton-in-Ashfield, containing a population of 6000, and flows through and relieves Mansfield, which has a population of 12,000. The average rent of these meadows is £4 10s., and their value in connection with the large arable farms, on the high ground, is very great. Those nearest to Mansfield, and which receive the first supply, are naturally most luxuriant.

At Carburton we found a very interesting case of light-land cultivation. An area of 2000 acres of arable land affords great scope for steam, and, notwithstanding drawbacks which a ripper experience might have obviated, we shall find results which are encouraging. Work was commenced October, 1862. The tackle consists of a nominal 12-horse-power traction-engine, by Richardson & Darley, "Kirton-in-Linsey"—a complicated affair. The engine has proved very unsatisfactory. The repairs for the first 3 years in new fire-boxes, tubes, &c., being enormous. The travelling gear, wheels,

&c., altogether unsuitable—Howards' apparatus, including 4-furrow plough, 5-tined cultivator, and 2000 yards of rope. The fields are generally large, varying from 18 to 120 acres, the land gently undulating—in fact, the conditions are very favourable to steam culture, though, from the sandy nature of the soil, there must be a considerable friction on the rope. With this exception repairs are inconsiderable. The cost of apparatus amounted to about £900, viz.—£500 for engine and £400 for cultivating tackle. 1600 yards of rope have been bought to replace old rope, and the present stock will barely last this season, being much worn. The cost of the new rope up to the end of December, 1866, was £71. The total acreage worked is stated to be as follows:—

	Acres.
Cultivated	1900
Ploughed	3600
	<hr/> 5500

The total outlay for ropes has been £142. Assuming the value at present time to be £25, the cost has been very little over 5*d.* an acre—an expense which will favourably compare with ordinary experience. The average work per day of 10 hours has been—

For light ploughing on level land with 4 furrows ...	7 acres
„ hilly work with 3 furrows	5 „
Cultivating 5 times	12 „

It was difficult to arrive at the amount of horse-labour displaced, on account of the work done by the farm-horses on the estate; but after a very careful investigation, we come at the following conclusion, viz.—that 50 horses would be employed without steam, whereas at the present time, 30 do the work: so we have thus a saving of 20 horses, and the value of their keep and attendance to place to the credit of the steam cultivating account. The corn is all cut by machinery, and occasionally horses are borrowed from other farms: we have fully allowed for this in our calculation. The average work per annum has been about 850 acres ploughed, and 450 acres cultivated, and on these figures we can base our calculations. Assuming the average daily work to be 6 acres ploughed and 11 acres cultivated, we get 180 days as the total time per annum.

On this calculation we have an annual cost of £570, against which may be placed the cost of 20 horses, and attendants, which cannot be valued at less than £900; so that, despite the extraordinary outlay for repairs, we have a large profit on the apparatus which we may anticipate to see increased in future seasons.

The cost per day is—

	£	s.	d.
*Labour	0	17	8
Horse for coals and water-cart	0	3	0
Oil and coals, 15 cwt.	0	9	0
†Repairs (chiefly on engine)	1	2	0
Wear and tear at 7½ per cent. on £800 (½ of engine deducted for thrashing)	0	6	8
Interest of money at 5 per cent.	0	5	0
	<hr/> 3	3	4

* Engine-man, 3*s.*; windlass-man, 3*s.*; ploughman and 2 anchor-men, 7*s.* 6*d.*; 5 boys, at 10*d.* 4*s.* 2*d.*; total, 17*s.* 8*d.*

† The amount of repairs, almost entirely on the engine, is altogether exceptional, and proves either that the engine is a thoroughly imperfect one, or that she has been greatly misused.

Such appears to be the cost of a day's work, for which we have 6 or 7 acres ploughed, 10 to 12 acres cultivated on land so light that it can be worked at any season, and on which a pair of active horses would plough 1½ acre in a day. Favourable as this result is, it might have been improved upon had the engine been more suitable. In May, 1866, in reply to questions asked by the Highland and Agricultural Society, it was stated that accidents had occasioned on the average, delays of 3 months annually, often at the time when work was most pressing. Since May, 1866, 420 acres were ploughed and 390 cultivated, notwithstanding the wet season. We found the machinery in operation ploughing after a root crop eaten on. The furrows were laid with great regularity, and barring the breaking of a rope, which caused a delay of half an hour, the progress was satisfactory.

OXFORDSHIRE.

HIS GRACE THE DUKE OF MARLBOROUGH, BLENHEIM PALACE.

LIGHT LANDS.—His Grace the Duke of Marlborough, Blenheim Palace, Oxfordshire, has employed a steam cultivator since October, 1861, upon stone-brash, light, and medium-loam land, having a subsoil of rubbly rock. The extent under occupation fluctuates according to what farms happen to be in His Grace's hands; the present area being 760 acres arable, besides 1590 acres of grass. The surface is tolerably level; and the inclosures vary from 35 to 40 acres. No new roads or other alterations have been made purposely to expedite field-work by the engine.

The apparatus consists of a Howards' 5-tined cultivator, with windlass, etc., driven by a 10-horse portable engine; which has broken up an average of about 9 acres per day, and over 1000 acres in each year; this amount of work occupying 130 days in each year, the days lost by bad weather being 9, and lost by breakages 3 days. This is a very concise statement, but valuable because of the scarcity of such accurate details; and it is very satisfactory that so great a breadth of work was got through with such a comparatively small amount of hindrance. Of course, "when not steaming," the hands are employed in farm-work. The manual labour is that of 5 men and 3 boys: the engineer 3*s.*, the other men 2*s.*, and the boys 1*s.* each per day, or 14*s.* for the whole force. Ordinary labourers' wages are 10*s.*; and carters, 12*s.* per week. The carting of the 350 gallons of water boiled away, costs 5*s.* per day; and a removal takes 8 horses and 4 men for 2 or 3 hours, which, done every fourth day, comes to about 2*s.* 3*d.* upon each day's work.* The engine has burned 8 cwts. of coal per day, at 15*s.* 6*d.* per ton, that is, 6*s.* 2*d.* a day, besides cartage, 2*s.* 6*d.* per ton; the oil has cost 1*s.*

What has been the wear and tear upon the large amount of work done by this apparatus? The repairs in the five years amount to £94, averaging on 130 days' work in each year 2*s.* 10½*d.* per day. Part of this sum is for new shares, and for repairing the axles and wheels of the cultivator; a quantity of exceedingly rough ground at first starting having worn these parts of

* That is the time actually employed, but with time spent in coming and going, the cost would be 3*s.* per day.—J. N.

the implement very much. The main item, however, was for a new rope the first rope was worn out within the three years, and had cultivated about 2300 acres. Still, this rate of wear was much more rapid than it is now, because they did not work a sufficient number of porters at first to hold up the rope off this stony land. A "double snatch-block" and extra porters were then procured, and have been found to save the rope a good deal, so that the present rope seems little the worse for two years' wear, and will certainly last over much more work than the other. According to this statement, furnished to us by the agent, Mr. James Napier, we may safely put the wear of rope at only 4*l.* to 6*l.* per acre for the sort of tillage done.*

"Interest" has to be computed upon the original cost price, £520, which with £21 for the "additions," consisting of the double snatch-block and rope-porters, makes the whole investment £541. Probably we shall be near the mark, if (deducting wearing parts) we take "depreciation" upon £450; reckoning both this and the "interest" at 5 per cent. each, and charging the two amounts upon the 130 days' work in a year, and upon 9 acres per day.

The several items per day and per acre, averaged from totals of five years carefully booked for more than 5000 acres of work done, will stand as follows :—

	Per Day.	Per Acre.
	£ s. d.	s. d.
Manual labour	0 14 0	1 6½
Water-carting	0 5 0	0 6½
Share of removal	0 2 3	0 3
Coal	0 6 2	0 9
Oil	0 1 0	0 1½
Working expenses	1 8 5	3 2
†Repairs	0 2 10½	0 3½
Depreciation	0 3 5½	0 4½
Interest	0 4 1½	0 5½
Total cost per day	1 18 10½	4 3½

The total annual outlay, for 130 days' work, will amount to £252 16*s.* 5*d.* But there is an error of excess in the calculation, arising from the whole of the depreciation and interest due upon the engine being charged to steam cultivation; whereas, this engine does all the thrashing of the farm, and the engine cost more than half of the purchase-money. A correction being made for this, would reduce the above totals probably 2*s.* per day, or nearly 3*d.* per acre, making the entire yearly cost of steam cultivation, say £240.

Twenty-six horses were employed before "steam" was introduced, and 20 afterwards; and reckoning the 6 horses at £44 per horse, the annual saving is £264. That is, the outgoings for tillage remain about as they were; the Duke getting all the advantage of deeper and more expeditious cultivation without paying a penny extra for it.

The effect of steam culture upon "strong land under drainage" (one point included in our "instructions"), may be here treated in the same way as "the snakes of Lapland;" the subject being foreign to the soil of Blen-

* Some further allowance must be made for time lost by breakage or other mishaps, also for cleaning and dressing the rope-porters, etc., items which, though trivial in themselves, come to a considerable amount in the course of a year.—J. N.

† Includes wear and tear of a rope 4*d.* to 6*d.* per acre.

heim. The system of cropping has not been altered, nor has the acreage of root-crops been enlarged. The advantage, as far as regards increased production, is thus stated by Mr. Napier:—"The root-crops have been considered better, by which other crops receive a corresponding benefit." Certainly, the Duke's swedes were the earliest, and, drilled wide and hoed-out wide, presented the biggest bulbs that we chanced to meet with in any English county. They had been "magnificently done;" but at the date when we walked through them (September 15th), we could not say whether they would not be beaten in quality by other rather backward swedes in the neighbourhood. The preparation for them was as follows: the land was steam "cultivated" and steam "crossed" in the autumn; then in spring it received one light cultivation, followed by harrowings and ridging in the usual way. The manure was 15 tons per acre of "farm-yard," and $2\frac{1}{2}$ cwt. of "superphosphate."

SHROPSHIRE.

MR. THOMAS NOCK, OF SUTTON MADDOCK, SHIFFNAL.

HEAVY LANDS.—Mr. Thomas Nock occupies 500 acres arable and 50 of pasture, in generally level fields from 9 to 16 acres in extent ("many fences taken up, and more should be"). The soil varying from strong loam with clay subsoil on most part, to red sandstone on the remainder. In April, 1862, he purchased a Howard tackle with 10-horse engine, costing £500. It cultivates 5 up to 10 acres per day, according to depth. Coals are burned at the rate of 12 cwt. per day, costing 10s. per ton. Water is supplied by horse and cart; five men are paid 2s. 6d. each per day, and three boys 1s. each; and taking up and setting down the apparatus (besides travelling) takes 2 hours. The engine does the farm thrashing. Mr. Nock says that the drainage is certainly improved; and also that the root-crops can be fed off with much more advantage. He has not altered his rotation of cropping. His team force is reduced from 18 horses "before" to 15 "now."

SHROPSHIRE.

MR. RICHARD PULLEN, SHACKERLEY, ALBRIGHTON.

LIGHT LANDS.—Mr. Richard Pullen, of Shackerley, Albrighton, works a Howard cultivating tackle, with a double-cylinder, 8-horse portable engine, on a farm of about 240 acres arable and 110 grass, consisting of sandy soil upon sandstone rock. His average performance in level fields, made from 10 into 20 acre pieces, is 8 acres a day; burning half a ton of coal, at 10s. per ton, using 2s. 3d. worth of oil, and evaporating 500 gallons of water, carted by one horse. Two of the men are paid 2s. 6d. each, three men 2s. each, and two boys 8d. each per day. A shift takes 8 horses for five hours. The engine does thrashing and other work, and also cultivates for neighbours at a charge of 10s. an acre once over, and 18s. twice over. Mr. Pullen gets more green cropping than he used to do; his crops in general, he says, are more productive, and of his former tillage force of 8

horses and 4 bullocks, he has dispensed with the 4 bullocks. The tackle was purchased in 1863 for £470 (the engine previously bought in 1861); it has been employed about 50 days in each year, and the repairs have consisted of a new rope and some few porters.

SHROPSHIRE.

MR. JOHN E. STANIER, OF UPPINGTON, WELLINGTON.

HEAVY LANDS.—In the vale, overlooked by the Wrekin, Mr. Stanier occupies 220 acres of arable, and 60 acres of pasture; all tolerably level, and in fields of 25 acres each (two being of 50 acres each) made by grubbing up $2\frac{1}{2}$ miles' length of fences. The soil is a strong loam and part clay, chiefly upon a clay subsoil. On this comparatively small occupation he has ventured to adopt steam cultivation; in March, 1864, he purchased a Howard tackle, with 3 and 5-tine cultivator and 3-furrow plough, and a 10-horse portable engine by Barrows and Carmichael, for a total of £690. Additions have cost £5; and repairs £20, with ordinary wear of rope, porters, etc. Coal, at 11s. per ton delivered, costs 3s. 4d. per day; oil, about 1s. 6d.; water, about 750 gallons, is drawn by horse and man from a water-work pipe. Six men and two boys are paid 13s. 6d. a day. And to shift takes 6 horses for 2 hours, if in the same or on an adjoining field. The quantity ploughed per day is 6 acres; and cultivated, 6 acres with the 3-tined, and 10 acres with the 5-tined cultivator.

The engine is employed 45 days on this farm, exclusive of delays from bad weather or from breakages, both of which have been very trifling. The engine also thrashes, pulps, grinds, and is let out to thrash for hire. In the spring of 1864 it cultivated 300 acres for neighbours, at 7s. to 10s. per acre; but the tillage is at present confined to this farm.

Mr. Stanier has dispensed with 4 out of 10 horses, and thinks he saves half the horse-corn on these. He considers that steam cultivation assists the natural drainage of the land, and has this winter profitably fed off turnips with sheep. He says, "My crops have increased so much as to excite the surprise of every one, and I consider the increased productiveness of the land entirely due to greater depth of cultivation obtained by steam power. Though, in my own case, the original outlay was great, and my farm a small one, I consider myself amply repaid in increased crops, greater depth of tillage, as well as cheapness and efficiency of work. Even the most sceptical of my neighbours now no longer doubts the numerous advantages of steam over horse power." He further writes of the great value of Howards' steam-harrows, which do 20 to 25 acres per day.

STAFFORDSHIRE.

MARQUIS OF ANGLESEY, SINAI PARK FARM, BURTON-ON-TRENT.

HEAVY LANDS.—Steam cultivation here goes on at the same time with, or is preceded by, works of permanent improvement, and the point of great importance is whether such outlay can be made to yield a fair interest. At

the original rent of 22s. an acre, the tenant was ruined, and the land, not deficient in minerals but drowned with water, was reduced to beggary. The work of improvement consists in thorough drainage, grubbing fences, clearing out water-courses choked up, fallowing $\frac{1}{3}$ of the land, and erecting suitable buildings. The outlay will probably come to about £20 an acre. Now we consider that steam cultivation has had much to do with all this outlay; the existence of this power may have in this, as it certainly has in other instances, induced proprietors to take such cases in hand, and by vigorous treatment, rapidly to affect a metamorphosis which, under ordinary conditions, would have required years. No one can deny that the more rapidly the transition is made, provided the work is done economically, the sooner will a return be obtained. The farm contains nearly 300 acres, of which 165 acres are arable; more, however, will be added. The soil is a strong drift-clay interspersed with boulders and limestones nodules: the latter, which occur at some depth, are from the mountain limestone; the former, principally on the surface, are millstone grit; whilst the whole overlies the red marls of the new red sandstone, in which occasional beds of gypsum are found. In the original state the surface is extremely wet, although, in consequence of the stones, it drains well.

The apparatus, which was purchased in October, 1864, consists of a 14-horse-power traction-engine by Aveling and Porter, a very strong and well-made machine, with Howards' windlass and cultivator and drag-harrows. Up to last spring the tackle worked on the home farm at Beaudesert. Since then it has been kept on to the Sinai farm, and did good service last summer in helping to fallow 124 out of 165 acres—doing work on the foul weedy surface which would have been simply impossible with horses. The apparatus does not require special comment; the windlass is driven by a crank shaft and universal joint, the patent sling snatch-blocks are used, and we saw a strong mole draining-plough for the grass land which might be used advantageously, but has not yet been tried. As no journal or separate accounts have been kept, it is difficult to arrive at a correct estimate of the cost of repairs. Porters and anchor sheaves seem most liable to breakage, and it appears to us that the latter are not sufficiently strong. We shall not be far out in charging the cultivating part with £20, and the engine with a like sum. The operations have been confined to fallows, and the cultivator has been used with 3 times only. The first operation, 8 to 10 inches deep, averages 5 acres a day, the second time over about 6 acres. In the spring the land is stirred 3 and sometimes 4 times. Present cost of wages is as follows:—1 engineer, 3s.; windlass-man and man with cultivator, 2s. 6d. each; 2 anchor-men, 2s. 4d. each; 3 porter-boys, at 1s.; and a lad for water, 1s. 8d.; total, 17s. 4d., to which we may add 3s. for the horse. The fields average about 15 acres, and are rectangular, tolerably level, and well adapted for steam. The condition of the farm was so deplorable that any attempt at regular cropping last year was abandoned, and it was determined to work as much as possible of the filth to the surface, and, had the season been ordinarily fine, the result would have been a clean farm; but, of course, success was only partial,—124 acres were worked all through summer, in many cases the operation being repeated 4 and 5 times. We may fairly assume that something approaching 500 acres were cultivated

last year in about 90 days. We could not learn the exact cost of the apparatus, but believe it to be about £700 and with these premises we make a calculation of the cost per day:—

	£	s.	d.
Wages and horse	1	0	4
Conls, 15 cwt. a day	0	9	0
Oil, 1 quart	0	1	3
Repairs	0	8	10½
Wear and tear and interest, at 12½ per cent.	0	19	5½
	2	18	10½

This gives the cost for last year as £265 0s. 7½d., or an average of 10s. 7d. an acre; a high price it must be admitted, but probably as cheap, considering the quality of the operations, as horse-labour. No information could be obtained as to saving in horse-labour, simply because so many horses are kept for hauling drainage and building materials. 15 to 20 extra horses would have been needed last summer to attempt the working of 124 acres of fallows in the condition of those on the Sinai Farm. We walked over most of the land and inspected the drainage, which appears to answer well. We found the drained land much drier after steam culture than when worked with horses, and we are convinced that the first deep operation by steam is of great advantage to the drainage. Mr. Bestwick, the bailiff, proposes to pay the hands 4s. an acre for the future, instead of the day pay—this will cover all labour except water and coal carting.

SUFFOLK.

MR. EDWARD GREENE, M.P., BURY ST. EDMUNDS.

LIGHT LANDS.—Mr. Edward Greene, the member for Bury St. Edmunds, eighteen months ago took the farm of 400 acres, near that town, which we visited September 8th. The soil is a good friable loam on a chalky subsoil, well suited for the growth of roots. The fields which lie on each side the turnpike road, are large; they are bounded by straight fences, which are without timber. There is a partial supply of water from ponds; the greater part has to be carted an average of three-quarters of a mile. The farm requires no drainage. When entered, the farm was exceedingly foul: already (since November, 1865) a change has been wrought, which is due to steam-power, and could have resulted from no other in so short a time. A decided, vigilant man, who professes to “farm on the gallop,” when he employs steam-power, will scarcely be satisfied with less than steam-pace. Mr. Greene farms on the four-course system, and intends to keep to it. If farmed so high for roots as to throw down the barley-crops, he believes it possible to stiffen the straw with salt.

The *Apparatus*, purchased November, 1865, consists of an

<i>Engine</i> , 12-horse power, double cylinder, traction, made by Burrell, of Thetford. It is used for thrashing and chaff-cutting. It is powerful and well made. The hind travelling wheels are 6 feet in diameter, and 12 inches across the tire. It drives the windlass with spindle and universal joint. Cost	£	400
<i>Windlass and Rope Porters</i> , made by Howard		
<i>Cultivator</i> , Mr. Kersy Cooper's design, made by Burrell		
<i>Three-furrow Plough</i> , by Ransome. <i>Boyc</i> , 1600 yards		
Total		750

Of *Repairs*, etc., there has been no separate account kept.

Work done, and Mode of doing it.—During a day of 10 hours, including removals, which occupy 2 hours, ploughing is done at the rate of 7 to 8 acres a day; and cultivating at about 10 acres a day, the first operation being 5 inches, the second 9 inches in depth. When days are long it is very usual to keep the engine running from 5 A.M. to 7 P.M. The steam plough is used only to turn the wheat-furrow, or to put in long manure for roots. Since November, 1865, 315 acres have been ploughed or cultivated once over.

The Cost of Work.—The men are paid by the piece. The four principals take the job at 1s. 10d. per acre, the men spending their own time about moving, the master finding the horse to draw the water-cart. The payment of manual labour is thus arranged:—

						Per Acre.
						s. d.
Engine-man	...	...	...	...	...	0 6
Windlass-man	...	...	...	...	...	0 3
Ploughman	...	...	...	...	...	0 3½
2 Anchor-men	...	...	...	...	...	0 5
Porter-boys	...	...	...	...	...	0 3
Water-boy	...	...	...	...	...	0 1½
						1 10
Coals	...	...	...	...	...	1 0
Oil	...	...	...	...	...	0 1½
Carting Water	...	...	...	...	...	0 4
Interest	...	...	...	...	...	1 6
Removals by horses	...	...	...	...	...	0 1½
						3 1
						4 11

Mr. Greene's mode of estimating the expenses—wear and tear, repairs, maintenance, and interest, is as follows. The total cost of the apparatus being £750, half the cost of the engine and all that of the apparatus—viz., £550—are set down to tillage operations thus—

	£	s.
Repairs, wear and tear, and maintenance, on £550 at 20 per cent.	110	0
Interest at 5 per cent. on £550	27	10
	137 10	

The horses are reduced from ten to six. In harvest, a couple of light ones are bought to help through with carting, and sold again when it is done. If the land were heavier, Mr. Greene would certainly have a double-engine set of tackle.

SUFFOLK.

MR. A. C. KING, DESNING HALL, HIGHAM.

MEDIUM OR MIXED-LAND FARM.—A long ride from Bury St. Edmund's over an open rolling country, timbered scantily and chiefly with fir, brought us to Mr. King's, who occupies 840 acres of land which have been in the family upwards of 70 years under a Mr. Farmer. Of this area 700 acres are arable, of which one-third is of heavy land, requiring 3 horses to plough 3 roods a day 6 inches deep, and the other mixed soil, upon which steam power has not been used. The heavy land lies mainly on the slopes of two contiguous hills, has a clay subsoil, and

never before was known to grow roots. We found it not only producing fine crops of mangolds and turnips, but allowing of their being fed off occasionally, which shows that drainage—rendered more effective by deep culture—and deep culture itself, have combined to improve the texture of the soil in a marked degree. The drainage is done 32 inches deep $1\frac{1}{2}$ rods apart. The fields lie in those large breadths so suitable to steam. The land which was in ridge and furrow, is now laid on the flat, and fed with sheep, a novelty in the district on land of this sort. 400 breeding sheep are kept on the farm, and also 20 to 25 cows; and the produce from all these is annually fattened on the farm for market; the sheep being sold at a year to fifteen months, and the bullocks between two and three years old. The supply of water is inconvenient: it has to be all carted from a pond and well at the homestead, for which one man and horse are sufficient. The water leaves very little deposit. The horse power has been reduced from 24 to 22, or 2 to 6½ acres, which is excessive. The covenants prescribe the 4-course system, but the tenant is satisfied that any reasonable wish which he may entertain would not be denied him.

The *Apparatus*, bought 1862, and manufactured by Messrs. Howard, consists of—

	£
A 12 horse-power, double cylinder, traction engine, by Burrell	335
1 cultivator, 1600 yards of rope, a windlass and porters	250
Total cost	585

The windlass is worked with connecting rod and universal joint.

The engine is furnished with a commodious house, where it stands to drive the mill to thrashing and chaff-cutting machines. The engine-driver is a well-trained farming man. The number of days it is working could not be stated, but it was not more than one-third of its time working on the land. The implements and rope well kept under cover.

Repairs, Renewals, Wear and Tear.—The engine was in very good condition. It is properly stayed to sustain a steam pressure of 80 lbs., but burns an excess of coal. We thought this probably due to the steam space being small—without a dome. The repairs of the engine, estimated by Mr. King, over a period of 4 years, at about £40, or £10 per annum, the prime cost having been £335. For the outlay on the steam tackle of late no account has been separately kept. He roughly estimates that the expenses of rope, engine and apparatus, including 10 per cent. for maintenance and renewal, have been 3s. 6d. per acre for each time of cultivating. Of this total, one item, 2s. 8d. per acre, is due to the rope and apparatus, and 1s. for the engine.

Work done and Mode of working.—During a day of 10 hours, including removals, 5 acres are completed, namely, cultivated and cross-cultivated, the implement going over 10 acres in a day. As yet, less than 100 acres have been worked twice each year. Mr. King expressed himself perfectly contented with this quantity for the past, but he intends to do more in future. He stands much in need of a plough. The clover-leys cannot be spared till the 15th September, and horses, which are not wanted the rest of the year, must, it is argued, be kept to do this and harvest work while the steam tackle stands idle. There are each year 175 acres of fallows, on

nearly all of which either roots or vetches are grown, and this is certainly due in great measure to the steam apparatus. The preparation for the root-crop is as follows:—In October, the land for mangold and early turnips is cultivated and crossed, and a Coleman's scarifier is run through the land just before sowing; this is generally found sufficient.

Cost of Work.

Manual and Horse-labour:—										£ s. d.		
Engine-man	...	...	...	...	...	...	...	...	...	0	3	0
Windlass-man	...	...	...	...	...	...	...	...	...	0	3	0
2 anchor-men	...	...	...	...	...	...	...	...	...	0	3	10
Steersman	...	...	...	...	...	...	...	...	...	0	2	2
2 boys	...	...	...	...	...	...	...	...	...	0	1	8
1 boy and horse	...	...	...	...	...	...	...	...	...	0	4	0
										0 17 8		
Coal	...	...	...	...	...	...	...	...	...	0	15	7
Oil	...	...	...	...	...	...	...	...	...	0	2	6
Daily working expenses										1 15 9		

N.B.—No extra payment to men. Coal—"Staveley Harbours," 18s. 4d. per ton home, consumption 17 cwt. per day of 10 hours, 15s. 7d.

The farm lay in a very creditable state, but we were struck with the comparative uselessness of machinery capable of rendering such unmistakable assistance, upon a farm of this kind, where horses, owing to the steepness of the inclines and the tenacity of the soil, work to great disadvantage. The consumption of fuel, too, is a serious increase to the expense. The charge per acre is somewhat heavy. Adopting Mr. King's mode of calculating the expenses, &c., the daily working expenses £1 15s. 9d. + the wear and tear and depreciation (£1 15s. 2d.), make in all £3 10s. 11d., which, spread over 5 acres, gives 14s. as the cost per acre completed. Mr. King considers that since the engine is employed only 20 days in a year for cultivation, and nearly 50 days on thrashing, &c., &c., only one-third of its cost should be charged to steam cultivation. The charge for interest would then be, on one-third of £335:—

										£ s. d.		
Cost of engine	...	...	...	...	...	...	...	...	...	111	13	4
Cost of other tackle	...	...	...	...	...	...	...	...	...	250	0	0
										361 13 4		

Interest on £361 13s. 4d. at 5 per cent., £18 1s. 9d., or, divided among 20 days, 18s. 1d. per day. The account would then stand thus:—

Daily working expenses	...	...	...	...	...	...	...	...	...	1 15 9
Wear and tear at 7s. per acre, twice cultivated	...	...	...	...	...	...	...	...	...	1 15 0
Interest at 5 per cent.	...	...	...	...	...	...	...	...	...	0 18 1
										4 8 10

Or 17s. 9d. per acre, twice cultivated.

SUSSEX.

LORD LECONFIELD, PETWORTH PARK.

MIXED LANDS.—His lordship's vehicle met us at the station, drove us through the beautifully-undulating park, where herds of deer were feeding under the protecting arm of stately beech-trees, to the farm which lies at

the extremity of the woods which skirt the park. There we were met by his lordship's bailiff, Mr. Smith. The shades of evening were descending, and we were prevented from forming so close an acquaintance with the operations at Petworth as could have been desired. That part of the farm over which we walked, we found in a high state of culture. The fields, formerly small, are now enlarged, and are naturally well supplied with water. The 4-course system of cropping is observed. The land is drained 4 feet deep, 2 rods apart. There are 700 acres—500 acres of it are stiffish, requiring 2 horses to plough 3 roods, 6 inches deep. Some will bear sheep-feeding, some not. Considerable improvement is said to have taken place in the produce per acre, and in the texture of the clay staple, which is due to drainage and deep culture. The fields are not well suited for steam culture, being very hilly, and the boulders near the surface. The statistics to be had were very few. His lordship, in 1861, bought a set of Fowler's tackle; later, he bought a set of Howards', which was mainly for the use of his tenantry, who do not seem to avail themselves readily of the privilege. Mr. Smith expressed himself very strongly in favour of the round-about system on land so hilly as this. The difficulty in moving the heavy 14-horse power engine about, he described as insuperable. Considering the steep inclines, the irregular fields, and the great boulders, he thought the fixed engine system decidedly preferable. The farms, too, in the neighbourhood, are very small.

Both sets of tackle include an engine; one of 14-horse power, and one of 10-horse power. Fowler's cost £1000, Howards' cost £700, in 1863, including one of Clayton & Shuttleworth's traction engines. The repairs, wear and tear of Fowler's, are estimated roughly at £50 a year. We had hoped to have received some particulars from another of his lordship's agents who has charge of Howards' tackle, which is placed at the disposal of the tenantry, and which was said to have done more work than Fowler's. He has not, however, sent us the particulars up to the time of going to press. The work done with Howards' averages 5 acres per day with the plough, and 7 to 8 acres with the cultivator, including removals, which consume half a day each, and the work of 6 or 8 horses.

The cost of manual and horse labour, coals and oil, is £1 9s. 2d. per day. Fowler's tackle averages 5 acres per day ploughing 8 to 10 inches, 6 to 8 acres cultivating 10 to 12 inches, inclusive of removals; the cost being £1 10s. 10d. for manual and horse labour, coal, and oil. The ordinary weekly wage in the neighbourhood is 11s. or 12s. The coal costs from 22s. to 26s. per ton home; Fowler's engine consumes 10 cwt. while working with 60 lbs. steam pressure. An intelligent blacksmith is employed on the estate. Fowler's tackle was set out to work, but the weather had been all against it. We have seen a better use made of steam elsewhere, but the farm is not well adapted, in Mr. Smith's opinion, for Fowler's tackle. That the farm was in a fine state of cultivation was rather due to the liberal application of manure and the keeping of sheep. Mr. Smith stated that the chief obstacle in that neighbourhood to steam was the first cost of the apparatus, and the limited extent of the farms. Still he thought that Howards' apparatus might be added with great advantage to the farming machinery required for the cultivation of 300 acres, Fowler's for 500 acres.

With respect to the advantage derived from working in large fields, we were assured that between breaking up a 30-acre field and a 9-acre field with Fowler's tackle, there was a difference of one-third in time. He spoke too, of the increased pace obtained throughout the farm, and the greater promptitude with which all tillage operations are performed.

SUSSEX.

MR. GEORGE MORGAN, NINFIELD, NEAR HASTINGS.

MEDIUM OR MIXED-LAND FARM.—This gentleman occupies his own land—260 acres—out of which 30 grow timber, and 20 are in grass, leaving 210 acres of arable, a loamy clay lying on a sand-rock subsoil very pervious to water. Only 70 acres have required drainage. In some portion the drains are laid 4 feet deep, 2 poles apart; the rest is drained irregularly to catch springs. There is a good supply of water, strongly impregnated with iron. The farm did lie in fields of 6 or 7 acres. The average size is now 20 acres. Much has been done on this farm, since its purchase in 1861, to fit it for steam cultivation. The surface, however, is very hilly, and it is so intermixed with other holdings that straight fences are out of the question, unless adjoining landlords will agree to "give and take." Through the farm runs a public road.

Mr. Morgan estimates that the apparatus has supplied the place of 5 horses during 3 years. At one and the same time a house and farm buildings had to be erected, and a foul farm to be made clean, which it certainly now is. It would have been "impossible" for him to have hauled the building materials, and done the work of the farm with less than 12 horses. When the haulage was being done, the farm work must have suffered neglect. He has had not more than 7 horses.

The course of cropping pursued is as follows: 1, roots; 2, barley or oats; 3, seeds; 4, wheat. The old system, in Sussex, was wheat, oats, and fallow and peas, where no beet. The crops are continually increasing—a fact which is due to a liberal supply of manure and good drainage, as well as to deep culture.

The *Apparatus* was bought, in the spring of 1861, of Messrs. Howard. It consists of a 10-horse power double-cylinder portable *Engine*, bearing Clayton & Shuttleworth's name; a 5-tine *Cultivator*, windlass, plough, and 1600 yards of steel-rope; £525.

The engine drives the windlass with a strap. It is used also for thrashing sometimes, when Bury & Pollard's mill-sails can catch no wind for grinding and chaff-cutting.

Repairs, Renewals, Wear and Tear.—The *engine* and tackle have cost about £20 at the yearly overhauling. Mr. Morgan calculates that if worked 100 days in the year, 20 per cent. on the prime cost would keep all in repair, and supply the means for a new set of tackle in 8 years. His would amount to a charge (taking half the price of the engine) of £75 per annum. 2 ropes of 500 yards each (£50) supplied since 1861. The rope and rope-porters have been the greatest expense. The inclines are so frequent and sharp that the porters are cut through in astonishingly short time.

Work done, and Mode of doing it.—During a day of 9 hours, 4 or 5 acres may be cultivated per day, 6, 7, 8, and 9 inches deep, which requires as great a strain as an engine will exert with 60 lbs. of steam. The work done in various fields from the 9th October, 1865, to the present date, is as follows :—a 16-acre field worked in October the 9th, 10th, 11th, 12th, 13th, 14th, and November 6th. The tillage executed once, twice, and some parts three times, amounted to 40 acres; which, divided by 7 days, gives $5\frac{1}{4}$ acres per day. The next was a field of 12 acres. The working days were the 7th, 8th, 9th, and 16th of November, 4 days to 12 acres (only once cultivated), or 3 acres per day. The apparatus worked during March, 1866, 10 days. 8 days in April were consumed in cultivating and harrowing 30 acres, which gives $7\frac{1}{2}$ acres a day. These facts are given, not to show the great use which was made of the apparatus, for less could scarcely have been done, but to show what really was done.

Cost of Work.

Manual and Horse-labour :—						£	s.	d.
Engine-driver	...	...	...	...	...	0	3	0
Ploughman	...	...	...	...	...	0	2	3
2 Anchor-men	...	...	...	...	...	0	4	6
Windlass-man	...	...	...	...	...	0	2	3
2 boys	...	...	...	...	...	0	1	4
1 boy and horse	...	...	...	...	...	0	4	0
						<hr/>		
						0	17	4
Coal and coke	...	...	...	...	...	0	10	6
Oil	...	...	...	...	...	0	1	0
						<hr/>		
						1	8	10

N.B.—Men are paid for overtime 3*d.* an hour. Fuel—Coke and coal; coke, 1*7s.* a ton; coal, 25*s.*; consumption, 8 cwts. per day of each.

This whole district appeared to us to be sadly in arrear, little or no spirit being observable in landowners or their tenantry. Rent ranges from 10*s.* to 25*s.* an acre, and yet we found that where the land was well farmed, an average yield of wheat was 4 qrs. per acre. We were told of tenants being under covenant to reap their white-straw crops with a sickle. The rate of wages in this part of Sussex, was, during last year, increased from 12*s.* to 13*s.* 6*d.* per week—the hours being only from 7 till 5, with an hour for dinner. Their labour is poor in quality, and dear in price.

SUSSEX.

MR. THOMAS LYON THURLOW, BAYNARD'S PARK, HORSHAM.

HEAVY LAND.—This gentleman has recently purchased this beautifully wooded estate, consisting of 2000 acres. A small portion of it has been let in small farms of 150 and 200 acres; the remainder, 1400 acres, are in the owner's own hands. Of this portion 900 acres are arable. The land had been much mismanaged, and was in an exceedingly poor and foul state. For picturesque beauty, nothing could be better than spreading tree, sprawling tangled hedgerow, and deeply-rutted lanes; but for developing the wealth of the nation, this neighbourhood is sadly in arrear. A

little light has been let into it lately by the construction of a railway which cuts through, and has a station on the estate, and looks astonishingly at variance with the water-logged soil, the rushes, and other evidences of England a hundred years ago. The sunlight is dealt out to the land through masses of wood. It is intended that the fields, which were of 3, 4, and 5 acres, should average 30 acres.

In prosecuting this work, about 600 acres have been reclaimed and rendered productive. The larger portion of the farm is heavy land; and though a portion of it is on the green sandstone formation, 450 acres are so stiff as to require the work of four horses to turn half an acre a day 6 inches deep. Part only of the requisite drainage is done, varying in depth from 4 to 7 feet deep, and from 1 to 2 rods apart. The benefit of deeply breaking up drained land cannot be disputed. The 4-course system of husbandry is followed; dead fallows are abandoned. Steam has substituted for dead fallow, barley, seeds, wheat; roots, barley, or oats; seeds, beans, or peas; and wheat. Drainage and deep culture have rendered much of the land capable of carrying sheep. A flock of Southdown ewes, selected from Rigdens and other good breeders, is being formed. Nothing but the boldest of measures will effect the cure here needed. Half-measures and timid counsels would, under such circumstances, be fatal to success; while a large expenditure, if directed with vigilance and judgment, must give large results. The working horses charged to the farm number 16, or 2 to 112 acres. When the same amount of land was divided amongst several tenants, they kept 2 to 56. The supply of water is good—generally from brooks, but partly from wells expressly dug to yield it.

The *Apparatus* was bought of Messrs. Howard, 1857.

The Portable Engine, 8-horse power, single cylinder, made by Clayton & Shuttleworth, is used in grinding, sawing, thrashing, brick-making. It has been driven 5 days a week

since 1857, and is provided with a commodious engine-house. Price £250

1 cultivator, windlass, 1400 yards of rope, porters, &c. 250

500

Additions and carriage 50

550

Repairs, Renewals, Wear and Tear.—Although the engine has been used, since 1857, five days a week, the average repairs were stated not to have exceeded £4 a year. The fire-box will probably last four years longer. The repairs are done by a man who comes annually from Clayton's, and his own smith. The engine-driver, formerly a labourer, is a careful fellow. He has been instructed by Clayton's men—the entire engine having been taken to pieces and reconstructed before him. One secret of the small expense may be that, the engine being provided with a lock-up safety-valve, the maximum steam-pressure allowed to the driver is 45 lbs. A new rope of 700 yards was supplied, in 1863, which will last two years longer. The heaviest repairs are in rope and rope-porters.

Driven only with 45 lbs. pressure, it may be considered that an 8-horse power engine is too weak for the work:

Work done, and Mode of doing it.—Removals occupy half a day with four horses and three men. A day's work, including removals, is 6 acres, from 5 to 6 inches deep. In 1865, from April 22 to Oct. 7, 28½ days, 237 acres

were broken up, 63 acres of which were three or four times done = $8\frac{1}{2}$ acres per day average.

Cost of Work.—The daily wage of ordinary labourer, 2s. 2d. The manual and horse labour amount to £1 0s. 10d.; the coal, oil, and grease, to 7s. 7½d. —in all, £1 8s. 5½d. per day. The windlass-man, whose work is looked on as the most difficult, receives 6d. a day extra. The coal is "hard," price 19s. per ton home; consumption, 6 cwts. per day of 10 hours, under cover, and 6 cwts. in the field.

The tackle was not at work, but was visible, under cover, and in very good state.

WARWICKSHIRE.

MR. PETER DAVIS, BICKMARSH HALL, NEAR ALCESTER.

HEAVY LAND.—Three or four sets of the Bedford tackle are at work within a short radius of Honeybourne Station, in a district of stiff clay, high-backed lands, and ploughing by 4 horses in a string. A few miles north of that place, between Evesham and Alcester, Mr. Davis farms 730 acres arable (and 245 acres pasture) of poor blue-lias clay; with beds of lias-limestone in a few of the fields, serving as natural drains to the land. No steep hill-sides exist upon the farm, and the country is generally level; yet it is customary to plough with 5 horses—Mr. Davis, however, using only four. The fields are of about 20 acres each, with sides straightened by the stocking-up of hedges, and with but few trees. No changes have been made in roads. The "normal force" of horses on this farm would be 38 to 40, certainly not fewer than 36; the introduction of a steam-cultivator has enabled Mr. Davis to sell off fully half his teams, and to carry his tillage-work before him with only 18 horses. Perhaps a pair more would be advisable, as the land, though generally pretty clean, has a few "outsides" that would pay for a little extra working. Here, however, we have an extraordinary displacement of draft-animals, equivalent, at £44 per horse, to a saving of no less than £792 a year (at the lowest number of horses formerly wanted), or £968 (at the highest number). Out of this, of course, have to be paid all the expenses of the steam tillage substituted. The extent cultivated or ploughed in a year is 360 acres, the depths of work being as follows:—In grubbing "bean brushes" for wheat, 5 or 6 inches is not exceeded, Mr. Davis believing that deep stirring immediately before sowing is wrong; but for fallow, and especially if early in the season, the tines are set in as deep as possible—namely, 7 to 9 inches. The ploughing for beans or mangold is done at a depth of 9 inches. We have not ascertained what Mr. Davis's steam-work actually costs him: but even if we assign it the excessive sum of 10s. per acre, his total expenditure on steam culture will be less than half the lowest amount at which we put his saving in horseflesh.

In 1863, Mr. Davis bought a 12-horse engine for £340, and has a Howard tackle with 3-tined cultivator, costing £250, to which is added a Fowler 2-furrow plough, costing £45. He had started with a Woolston tackle, but broke the cultivator, and cracked off the flanges of the rope-drums by the pressure of the coils. The Bedford apparatus has stood well, and, though

the "repairs" have not been serious—having been chiefly done by a blacksmith on the farm—the wear of rope has been enormous, a new rope having been required about every second year. This will give some idea of the extraordinary tenacity of the clay, which, as already said, pulls 4 horses so hard in a common plough, that the country custom is to use five; and the 12-horse engine, burning 12 cwt. of coal per day (at 16s. per ton) ploughs or digs only $3\frac{1}{2}$ acres a day, and cultivates 7 acres a day. Five men and 3 boys work the tackle, being paid 3s. an acre for cultivating, and 5s. 6d. an acre for ploughing or digging. Water, 700 gallons in a day, is carted by one horse and boy. Shifting occupies 8 horses for 4 hours; that is, half-a-day, more or less, according to distance. The engine is used occasionally for thrashing, grinding, straw-cutting, &c.; but no steam-work is done off the farm.

In the absence of Mr. Davis, the son (as sound, intelligent, and business-like a young farmer as we have had the pleasure to pick up for some time) conducted us over the stubbles and fallows. The wheat-stubbles were wonderfully strong, and spoke well for something else besides wide-drilling—here 11 and sometimes 12 inches between the rows. Deep-tillage, young Mr. Davis assured us, does answer well for the wheat-crop; but then it must be done in July, or at any rate very early, and their tackle is kept busy throughout July, September, October, and November. Then the levelling of the old high-backed ridges he finds to be quite right; only it must not be done at once, but gradually, by working the steam-implements across ridge and furrow, so as in process of time to wear them horizontal. The drainage (thanks to steam cultivation) acts well on those fields which have already become perfectly flattened. The double-crop system is well-practised here; we saw beans in wide double-rows, with very good turnips growing in the intervals. Root-crops are now grown to a considerable extent in place of dead-fallowing, and are consumed on the land by sheep. The chief alteration in the cropping has been the substitution of lucerne for clover, owing to the frequent failure of the plant.

In Mr. Davis's case, we may sum up the resultant advantages of steam culture thus:—He saves very considerably (indeed, we should say, very largely) in his outgoings for tillage; he greatly increases the acreage of root-crops; and his grain-crops yield far better than before,—all being attributed by him to "steam cultivation and thorough drainage."

In a letter, dated February 18th, 1867, Mr. Davis says:—"I write to say that, since we finished cultivating in November, 138 acres have been *ploughed* for beans, peas, and mangolds, at a season of the year when none, except the roundabout system, is available. Now this, I consider, is a great object in a year like the last, when so much hindrance from wet weather occurred."

WORCESTERSHIRE.

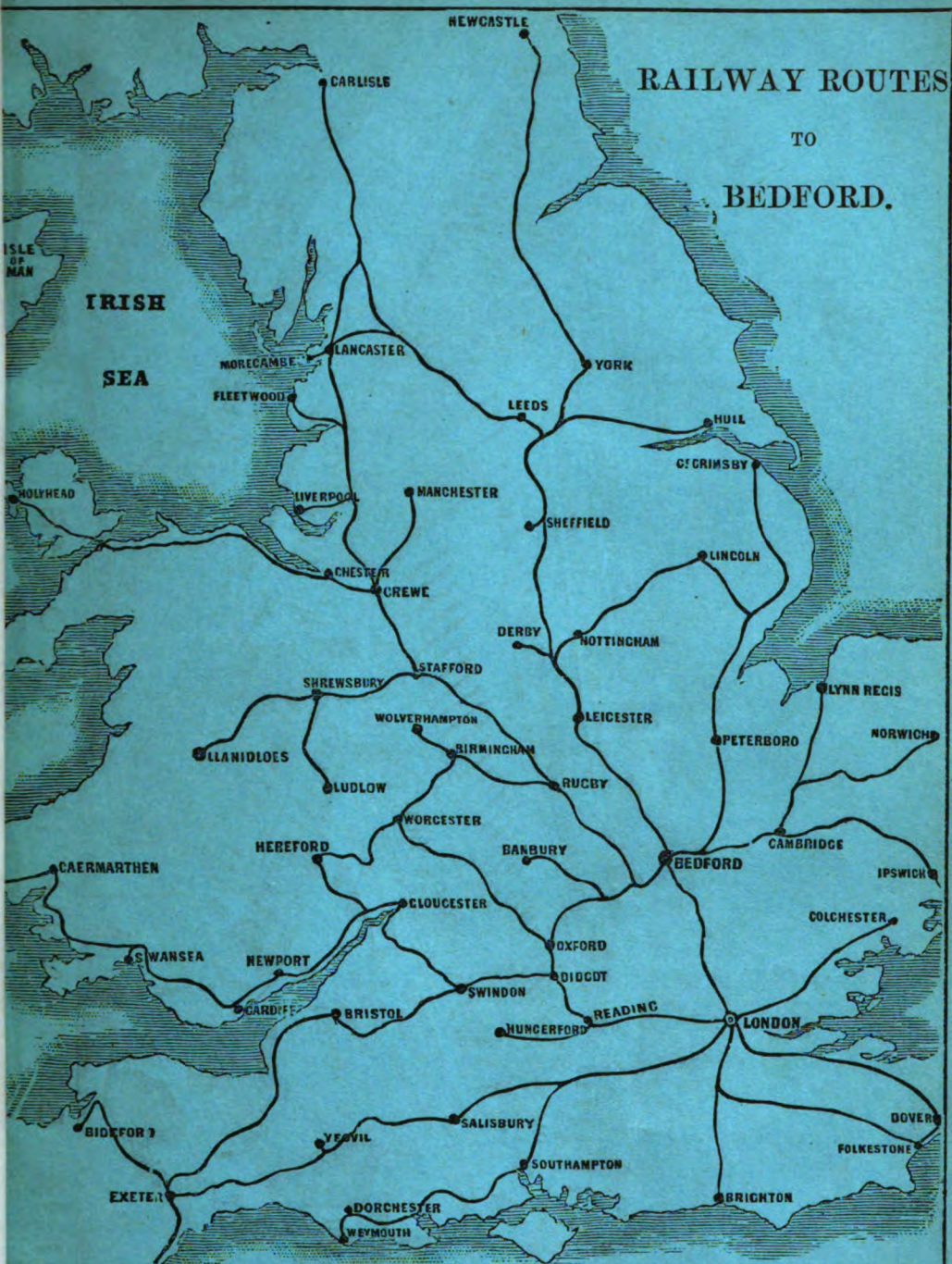
MR. J. HIGGINBOTTOM, OF PENSAX COURT, TENBURY.

HEAVY LANDS.—Mr. J. Higginbottom, has a Howards' tackle, with 5-feet cultivator and steam-harrows, driven by a Robey and Co.'s 10-horse engine. The whole was bought, in 1863, for £900; and the repairs since have cost

about £90, inclusive of £40 for rope. With more care in working, the repairs would be less. The farm, principally stiff land resting on clay, but partly light soil with sandy subsoil, includes 420 acres arable and 680 pasture and orchard. The fields are of only 12 acres average size, and very hilly. The grubber does about 6 acres a day; the engine consuming half a ton of coal, at 8s. per ton; coals being found on the estate and fetched by the horse that carts the 5 or 7 hogsheads of water for the engine. Five men and four boys work the tackle; total wages 16s. per day. A shift occupies three horses for five hours. The engine is used for driving a saw-mill, grinding-mill, and chaff-cutter. Mr. Higginbottom observes an improvement in the drainage; he has increased his area of root-crops, and his crops generally have been made more productive.* There are now only 9 horses kept upon the farm.

* A good portion of the land was turned up in the autumn and afterwards thrown up into ridges, the ridging-body being fixed upon one side of the cultivator and the subsoiler on the other; so that from the top of the ridge to the bottom of the subsoiler the land was stirred to a depth of 18 inches. The result is, that very stiff land is a fine tilth, and with one good stirring, fit to receive the barley-seed.—G. H.





RAILWAY ROUTES TO BEDFORD.

TIME OCCUPIED IN TRAVELLING TO BEDFORD.

BIRMINGHAM, from New Street Station	-	-	-	-	-	-	2½ hours.
BRISTOL, from Great Western Terminus	-	-	-	-	-	-	5 hours.
CAMBRIDGE	-	-	-	-	-	-	1 hour.
CARLISLE, via Ingleton	-	-	-	-	-	-	7½ hours.
LEEDS, from Wellington Station	-	-	-	-	-	-	4½ hours.
LIVERPOOL, from Lime Street Station	-	-	-	-	-	-	5½ hours.
LONDON, from King's Cross Station	-	-	-	-	-	-	1 hour.
OXFORD	-	-	-	-	-	-	2 hours.



THE BRITANNIA IRON WORKS, BEDFORD.

A. Foundry. B. Engines and Fitting Shop. C. Forging Shop. D. Forging Shop. E. Escalating Shop. F. Timber Shop and Stop. G. Office. H. Entrance. I. Forwarding Warehouse.



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JULY 1, 1867.

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HOWARDS'

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